The Commonwealth of Massachusetts

2012 OPERATIONAL RESPONSE PLAN TO REDUCE THE RISK OF MOSQUITO-BORNE DISEASE IN MASSACHUSETTS

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This document is open to continual review and evaluation and can be modified, if and when appropriate

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Introduction

Mosquito-borne viruses such as Eastern Equine encephalomyelitis virus (EEEv) and West Nile virus (WNv) have been and continue to be the cause of disease outbreaks in humans and animals in Massachusetts. These viruses can cause illness and death in humans, horses and other wild and domestic animals, as well as diverse kinds of native, exotic, and farmed birds such as emus. Even though vaccines exist to protect horses and promotion of personal protective measures such as using repellents, community-level mosquito control can also be a practical and meaningful method of protecting people especially when risk levels of virus become high or critical. Efforts to reduce risk of arbovirus transmission include but are not limited to public awareness and prevention, standard mosquito control methods utilized by established mosquito control projects applied to alleviate mosquito annoyance, as well as intensified ground-based treatments (when and where feasible) and aerial adulticide applications, whether targeted or over widespread areas, to suppress populations of infectious adult mosquitoes to reduce and/or halt a mosquito-borne disease episode or epidemic.

Purpose and Scope

This document (hereafter referred to as the Plan) describes the role and activities of the State Reclamation and Mosquito Control Board (SRMCB) to counter the threat of mosquito-borne diseases in Massachusetts such as EEEv and West Nile Virus (WNv). In particular, the plan identifies and highlights the important partnership between the Massachusetts Department of Public Health (MDPH), Mosquito Control Districts (MCP's), Mosquito Advisory Group (MAG) and the Executive Office of Energy and Environmental Affairs (EOEEA), in responding to a mosquito-borne disease event or emergency. This plan is intended to serve as a companion document to the most current version of the MDPH Arbovirus Surveillance and Response Plan (See Appendix 15). Invariably, the document is open to continual review and evaluation and can be modified, if and when appropriate. Currently, this document categorizes the roles of the key agencies responsible for characterizing risk and planning operational response. Finally, it provides protocols (see Appendix 3) for evaluating efficacy and environmental impact of an intervention such as aerial adulticide application.

This plan:

- Describes the respective roles of SRMCB, MDPH, MCP's, MAG and others as well as the manner by which they shall interact and collaborate to ensure a coordinated and rational response to mosquito-borne disease risk.

- Contains a response structure (see Table 1 - Summary of Operational Response Plan Responsibilities and Appendix 1 - Detailed SRMCB Response Matrix to Prevent or Reduce Mosquito-Borne Disease) that summarizes the operating

characteristics and structural components needed to protect against, and respond to a mosquito-borne disease event.

- Outlines a multi-agency response when the threat of mosquito-borne illness warrants aerial application(s)

- Describes and highlights the specific activities and components that are being conducted and supervised by the SRMCB concerning any mosquito-borne incident.

Authority

The authorities of participating state and local agencies to respond to projected or current outbreaks of mosquito-borne disease and to exercise powers where necessary include:

- Chapter 252 of the Massachusetts General Laws (MGL) establishing the State Reclamation and Mosquito Control Board (SRMCB) and procedures for creating local control as well as eradicating (abating) mosquitoes in infested areas whenever it considers such activities to be necessary or useful. Under section 8 of Chapter 252, if the SRMCB concludes that certain improvements will benefit public health, the costs be paid by the Commonwealth, and the SRMCB must separately estimate that part of the expense, to be included with other estimates under MGL Chapter 29, Section 4.

- Chapter 132B of the Massachusetts General Laws (MGL), the Pesticide Control Act, designates the Department of Agricultural Resources as the lead state agency for implementing and administrating the Act and the Massachusetts pesticide program. Under this law, MDAR is responsible for registering all pesticides for use in the Commonwealth and for issuing all certifications and/or licenses in their legal use.

- Chapter 17 sections 2A of the Massachusetts General Laws states that upon declaration by the governor of a public health emergency, the Commissioner of Public Health may, subject to the approval of the governor and the public health council, take action to assure the maintenance of public health and the prevention of disease.

Roles and Responsibilities

Roles and responsibilities of key agencies involved in conducting mosquito-borne virus surveillance and response are outlined in the *Response Matrix* (*see Table 1 - Summary of Operational Response Plan Responsibilities* and *Appendix 1 - Detailed SRMCB Response Matrix to Prevent or Reduce Mosquito-Borne Disease*).

The matrix summarizes and identifies the duties of each agency, and their respective roles, as they relate to surveillance and intervention efforts. The MDPH and SRMCB are the two principal agencies responsible for the monitoring, detection, analysis, and implementation of operational interventions to protect public from mosquito-borne diseases in Massachusetts. In addition, a mosquito advisory group (MAG) has been

established as a non-governmental partner to provide technical, expert advice to the SRMCB.

Massachusetts Department of Public Health (MDPH)
MDPH-BLS (Bureau Laboratory Services) responsibilities include performing surveillance of mosquito-borne viruses, providing risk assessments, disseminating public information relating to mosquito-borne disease, as well as providing advice to the SRMCB on appropriate risk management for these virus infections. MDPH's central responsibility is to characterize the severity of risk associated with mosquito-borne diseases such as EEEv and WNv. This characterization is based on the most current MDPH State Surveillance and Response Plan, which describe the steps and protocols for collecting and evaluating data for indications of a potential or current mosquito-related public health problem. MDPH Arbovirus staff analyzes surveillance data and issue weekly- summaries that include a current risk assessment on a dedicated MDPH website.

These arbovirus reports are also distributed to key state agency and MCP personnel via email. The SRMCB and the regional MCPs collaborate with MDPH surveillance effort by collecting additional field data for MDPH analysis.

The MDPH Bureau of Environmental Health (BEH) is responsible for addressing health concerns related to pesticide applications. If an aerial application is undertaken, the MDPH/BEH implements a surveillance system for possible pesticide related illnesses as reported by emergency departments in the area of application or the Poison Control Center, as well as by local health officials and individuals calling MDPH/BEH directly. In addition, MDPH/BEH works with DEP and toxicology staff to develop recommendations on the choice of pesticide product for use in aerial application and develops a question and answer on health concerns related to the pesticide product used in aerial applications. This fact sheet is available on the MDPH/BEH web site (**see Pesticide Spray**) under the heading Environmental Exposure Topics.
http://www.mass.gov/?pageID=eohhs2subtopic&L=5&L0=Home&L1=Consumer&L2=Community+Health+and+Safety&L3=Environmental+Health&L4=Environmental+Exposure+Topics&sid=Eeohhs2

State Reclamation and Mosquito Control Board (SRMCB)
The State Reclamation and Mosquito Control Board is responsible for overseeing mosquito control in Massachusetts, whether in response to a public health situation or to reduce the overall annoyance caused by mosquitoes. The SRMCB provides a resource to municipalities statewide pertinent to mosquito-associated concerns, and works cooperatively with MDPH regarding all aspects of planning and response for mosquito-borne viruses that pose a risk to human health.

Pursuant to Chapter 252 of the MGL, the members of the SRMCB are appointed and represent the DAR, DCR, and DEP. The Board is housed in the Department of Agricultural Resources.

The nine organized mosquito control districts or projects located throughout Massachusetts operate under the aegis of the SRMCB pursuant to the provisions of

Chapter 252 of the Massachusetts General Laws and special legislation (individual and Resolves) that created them. Each MCP operates under the direction of a Commission. The SRMCB issue certificates and appoints Commissioners who carry out improvements on behalf of the SRMCB.

The MCP Commissions represent the interests of the member communities of the MCP and their residents by providing oversight of MCP activities. The MCP Commissions strive to insure that the member communities receive services that are consistent with applicable laws and justified by tenets of Integrated Pest Management (IPM), public health, vector control, environmental safety, and fiscal responsibility. The MCP Commissions consider the input and respond to questions from community official and residents.

In accordance with the most current version of the MDPH Arbovirus Surveillance and Response Plan, MDPH notifies the SRMCB, MAG, and regional MCPs of surveillance data indicating increasing levels of arbovirus risk. The MDPH Arbovirus Surveillance Program (BLS) informs relevant MCP superintendents and local BOH officers of positive isolations of EEEv and/or WNv. The MCPs, in turn, provide feedback to SRMCB and MDPH regarding abundance and developmental indices and trends for mosquito species of greatest epidemiological significance. MCPs may be directed by the SRMCB to increase or intensify ground control larvicide and/or adulticide applications, when and where, feasible to counter threats relevant to EEEv and/or WNv risk.

Once MDPH-BLS has characterized a situation of critical risk, justifying action to reduce transmission risk, the SRMCB weighs options and strategies for interventions. Intervention options may include ground-or aerial delivery of larvicides, ground-or aerial application of adulticides, and joint public service advisories. The SRMCB would consult with MAG . After careful risk assessments based upon scrutiny of diverse ecological, epidemiological, operational, meteorological, and financial considerations, the SRMCB would advise its respective state commissioners (DAR, DEP, DCM) and/or their representative, other pertinent state agency representatives, as well as the Secretary of EOEEA of the intervention(s) that are deemed warranted.

If risk of a mosquito-borne disease outbreak occurs or becomes widespread (covering multiple jurisdictions), MDPH will confer with local health agencies, SRMCB and MCPs to discuss the use of intensive mosquito control interventions beyond the standard measures employed by MCPs to reduce risk of human infection. The SRMCB will advise state agency Commissioners and the Secretary of EOEEA on interventions to reduce mosquito populations based on MDPH findings and characterization of risk. When a decision is finalized, the SRMCB's primary role is operational regarding the implementation and supervision of any state-funded aerial adulticide intervention.

SRMCB Mosquito Advisory Group (MAG)

The SRMCB created the Mosquito Advisory Group (MAG) to provide independent, scientific advice to the SRMCB regarding the justification, timing, location and options for intervention tactics such as to prevent and/or suppress and contain infected mosquito populations that may otherwise result in an outbreak of disease in people and animals. Members of the MAG are recognized experts in their fields and provide

valuable independent assessments and recommendations to the SRMCB. The MAG members were selected primarily by the SRMCB; with input and approval from MDPH-BEH regarding individuals with toxicological expertise. The 5 member Mosquito and Mosquito-Borne Disease Advisory Group are comprised of the following independent experts found and listed in **Appendix 14** and serve voluntarily on an as needed basis.

A key role of MAG is to advise SRMCB if, when, and how to conduct or intensify proactive efforts to suppress certain mosquito populations ***before*** the force of transmission increases to pose enhanced risk to people. Based upon evaluation of assessments from MDPH, MCPs, MAG, and other agencies, the SRMCB will advise its respective state agency Commissioners if an aerial intervention is justified, and the details (timing, location, method) of the proposed effort.

The MAG monitors entomological and epidemiological communications, data, and information regarding mosquito population species activity and abundance. MAG members may participate in pre-season workgroups established by MDPH or SRMCB. MDPH, DAR, DCR, MCPs and other agencies are expected to communicate relevant data as well as their concerns to SRMCB, and these data/issues will subsequently be considered by MAG.

Mosquito Control Districts (MCPs)
Regional and established Mosquito Control Projects (MCPs) serve as critical elements in the surveillance network, and in performing and facilitating intervention efforts to reduce the burden of mosquitoes and mosquito-borne diseases. MCPs cooperate effectively with MDPH –BLS by coordinating the placement of traps, collecting, and identifying and submitting mosquitoes and associated data in a timely manner to MDPH-BLS. MCP personnel have greater knowledge of local habitats and suitable field equipment that may be rapidly deployed to reduce populations of mosquitoes, and consequently, the transmission of mosquito-borne viruses. MCPs provide weekly summaries to the SRMCB on mosquito abundance and diversity as well as on local conditions that may be conducive to mosquito development and survival. These summary reports of local conditions aid the MDPH Arbovirus program and are incorporated in SRMCB/MDAR analyses and summary information.

Other EOEEA agencies
Other EOEEA agencies such as DEP, DFG, DFW and the EOEEA Secretary and Public Relations Office along with DPH (BID, BEH, BLS) and DAR/SRMCB will engage and contact appropriate personnel as needed to participate in planning and facilitating interventions, particularly in terms of public relations and environmental monitoring. (*See flowchart below*)

Multi-Agency Response Flowchart
Aerial Adulticide Application in Response to Mosquito-Borne Disease Threat

1. Determination of Response

- When human risk is elevated to a high level of concern as indicated by the MDPH Surveillance and Response Plan; DPH/BID-BLS will determine, in consultation with Mosquito Control Projects, SRMCB and the Mosquito Advisory Group whether aerial application is warranted.

Multi-Agency Response Flowchart (cont'd)

2. Characterization of Area of Risk

- Once consensus is obtained, DPH/BID-BLS characterizes the area of risk and delineates the perimeter of the spray area based on mosquito and virus surveillance.
- DPH/BID provides the GIS perimeter map to inter-agency collaborators as soon as possible.

3. Commissioner Certification

- DPH BID requests Commissioner of Public Health issue a "*Certification that Pesticide Application is Necessary to Protect Public Health*"

Action Items 4a-4c Occur Simultaneously:

4a. Determination of Appropriate Pesticide

- Prior to July 1 of each season, DPH/BEH and DAR will determine the type of pesticide to be used in the event that an aerial application will be warranted and obtain any EPA pesticide waivers, if necessary, for use in aerial application.
- In the event that aerial application is warranted, DPH/BEH and DAR will confirm this selected pesticide for use.

4b.Determination of No-Spray Zones

- No- aerial spray zones (mosquito treatment sensitive areas data layers) defined:
  1)Certified organic farms
  2)Priority habitats for spray sensitive state-listed rare species
  3)Surface water supply resource areas
  4)Commercial fish hatcheries/aquaculture
- DAR reviews any emergency waivers needed to use pesticides on school property and ensure compliance with pesticide laws.
- DAR/SRMCB will submit a 'Notice of Intent' to EPA to obtain an NPDES permit within 30 days of the aerial adulticide event.

4c.Exclusion/Inclusion of Priority Habitats:

- DPH/BID will determine, in consultation with SRMCB, DAR, DEP, and DFW if spraying in mosquito treatment sensitive areas is necessary to protect the public health.
- If spraying in these areas is necessary to reduce the risk to public health then:
  - DPH BID requests a permit from DFW be issued to DAR for taking endangered, threatened, or special concern species.

Multi-Agency Response Flowchart (cont'd)

5. Preparation of Final GIS Data Map

- DAR coordinates compilation of mosquito treatment sensitive areas data layers (no-spray zones) developed by DAR, DFW, and DEP within designated DPH spray area into a final map.

6. Environmental Monitoring

- DEP, DAR, and DPH/BEH notify partner environmental agency collaborators of planned environmental monitoring to provide opportunity for input/collaboration.DEP, DAR, and DPH/(BEH/BLS) initiate plans for pre/post-monitoring for public drinking water reservoirs, honey bees, macro-invertebrates (*discontinued in 2102*), and cranberries in designated spray area.

7. Emergency Room and Poison Control Contacts

- DPH/BEH contacts and provides pesticide illness surveillance protocols to emergency departments, poison control centers, and local health departments.

8. Notification of Date and Time of Aerial Application

- DAR and DPH provide public notices regarding the locations, dates, and times of aerial spraying.
- DAR will maintain a website with GIS maps of the aerial spray area and will update this site daily during spray operations.
- DPH will provide recorded hotline information regarding the spray zone, precautionary measures, and telephone numbers to report fish kills or other environmental impacts.

9. Operational Procedures-Aerial Application

- DAR/SRMCB initiates aerial spray operations using collective guidance and consensus developed through multi-agency, cross secretariat process.
- The aerial application operational procedures are followed as described in the SRMCB Operational Response Plan.

DPH- Department of Public Health
BID- Bureau of Infectious Diseases
BEH- Bureau of Environmental Health
BLS- Bureau of Laboratory Sciences

DAR- Department of Agricultural Resources
SRMCB- State Reclamation and Mosquito Control Board
DFG-Department of Fish and Game
DFW- Division of Fisheries and Wildlife

Internal Communication Processes
When mosquito-borne disease is projected to be a threat or during an outbreak, each of the SRMCB members report significant findings and concerns to their respective state agency Commissioner and/or another designated official within their respective agency to ensure that important mosquito-borne disease risk information flows to Secretary of EOEEA.

Diverse information relative to disease risk and mosquito control intervention options will be efficiently and freely communicated and carried out in three steps amongst the primary agencies of MDPH, SRMCB, and the MCPs.

1. MDPH Weekly Reporting
The MDPH BLS-Arbovirus Program generates, distributes, and posts weekly Arbovirus Surveillance Program Reports. These reports summarize the results of mosquito trap collections from the prior week and other pertinent data. This information is forwarded to key personnel including but not limited to members of the SRMCB, mosquito control personnel, MAG members, state Commissioners from DAR, DCR, DEP and others within EOEEA. Also, MDPH BLS-Arbovirus Program convenes telephone conference calls during the mosquito season to provide current status and updates of arbovirus activity including summaries of isolations or cases in adjoining states.

The weekly reports comprise current and historical data including:

1) Mosquito Surveillance at DPH long-term trap sites (*Cs. melanura* abundance, number and size of pools tested and infected (EEEv and WNv) and Cs. melanura infection rates;
2) Equine/ Mammal Surveillance (Number of veterinary infections and death by species (horse, emu, alpaca, etc) and virus (EEEv and WNv) ;
3) Human Surveillance (Number of cases of infections and deaths by virus (EEEv and WNv) ;
4) Current Risk Classifications for EEEv and WNv by municipality and county.

2. *SRMCB/MDAR Analysis*
The MDAR entomologist (state entomologist) regularly reviews each MDPH/BLS generated Arbovirus Surveillance Program Report, in concert with other data provided by MCP superintendents to assess the extent of any risk, and forms an opinion regarding the justification and urgency for a response. As the mosquito season evolves and when risk levels become a concern briefings on the current conditions are distributed by e-mail to key personnel by the MDAR entomologist (state entomologist). These reports may be sent bi-weekly and more frequently, if and when, required. Recipients will include SRMCB, MCP personnel, MAG members, state Commissioners from DAR, DCR, DEP and others within EOEEA as well as MDPH key personnel such as the state lab director and arbovirus surveillance program manager**.**

3. *MAG/SRMCB Analysis*

If an apparent or emerging risk appears imminent based on data and analyses from MDPH-BLS State Arbovirus program, MDAR entomologist , MCPs or other entities, MAG will evaluate available data sets, describe, and prioritize strategies for intervention (method, location, timing), and advise SRMCB of their recommendations. Key MDPH Arbovirus staff such as the state lab director and arbovirus surveillance program manager shall be copied on the recommendations made by the MAG to the SRMCB. SRMCB will take these recommendations under advisement, and may seek further comment and clarification from MDPH, MCPs, and other officials or senior managers within their respective state agencies.

If and when intensified interventions such as aerial adulticiding, are deemed justified, the SRMCB shall contract with credentialed mosquito control vendors to perform the service (See Appendix 13).

Because the window of opportunity to respond is time limited, the decision-making process is designed to progress rapidly and efficiently, with only a few days from the MAG input and MDPH's risk assessment determination to the decision to conduct an aerial spray operation. The SRMCB has developed this plan to facilitate an appropriately rapid response as a result of a transparent decision-making process, given the short time and many steps needed to determine and implement best management practices to reduce projected or current mosquito borne disease threats.

Public Information, Communication, and Media Notification

The SRMCB will designate a spokesperson in advance of a potential mosquito-borne disease incident. This person will be knowledgeable, credible, and have good communication skills. This individual will not, however, be responsible for overseeing, or facilitating operational details for any such incident. MCP personnel can defer questions to the designated spokesperson and/or answer questions directly pertaining to the issues taking place in their own district area. Public information developed in collaboration with MDPH and others will be used in this plan and in media kits designed to communicate timely and accurate information to the public as far as in advance as feasible or during any mosquito-borne disease incident. Finally, SRMCB/MDAR will work with the EOEEA Public Relations office and the MDPH Office of Public Health Strategies and Communication to ensure a standardized framework for communications and information sharing. The framework for communication include but are not limited to a system where the major media outlets are contacted via an electronic list of facsimile numbers by region, e-mail distribution lists, and web-based resources. The framework for communication will target messages that explain to the media, BOHs, and public a description regarding the kind, location, and extent of any mosquito-borne incident, instructions to public, benefits and risks of the planned intervention, fact sheets, frequently asked questions materials and contact lists for further information.

Notification of Key Contacts
In the event of a mosquito-borne disease event or emergency, the SRMCB will contact key personnel who will assist in any operational response, including the contact of entities requiring notification such as beekeepers, growers, certified organic farms and fish farms. Accordingly, GPS coordinates for certified organic farms; commercially licensed aquaculture operations, and other sites to be excluded shall be available in advance and uploaded into aircraft operational software (Appendix 10 and 11). Because beehives are frequently relocated throughout the season, the SRMCB has established a notification tree and will request the state chief apiary inspector to contact County Bee Association Presidents concerning the timing and location of aerial application activities; these representatives will, in turn, notify their members (See Appendix 12).

Environmental Monitoring
In the event that a decision is made to conduct aerial adulticide intervention(s), specific environmental monitoring will be pursued to determine effects (if any) on drinking water supplies, benthic macroinvertebrates (discontinued-see Appendix 7), and honey bees. The SRMCB through the respective agency each member represents (DAR, DEP, DCR) will activate and follow through with monitoring response protocols relating to **water supplies** (*even though water supply reservoirs are specifically excluded from the spraying operation*). Also, monitoring conducted on **aquatic macro invertebrates** in 2006 and 2010 has been discontinued in 2012 (See Appendix 5 & 7 for discussion of potential impacts from DEP-ORS). In addition, monitoring will be conducted to assess potential effects on **honey bees.** (See Appendix 6) and state listed invertebrates (See Appendix 9).

The sampling protocol for water supplies will assess any potential impact of the mosquito control spraying to drinking water. Monitoring activity will seek to assess the extent, if any, pesticide-related impacts to water supplies during and following aerial application operations. (See Appendix 8).

The sampling of surface waters and biota as outlined in the monitoring plan for pesticides/benthos has been discontinued for 2012 in conjunction with aerial application (See Appendix 7 Biomonitoring Memorandum).

Finally, in addition, MDPH (BEH) will coordinate pre and post aerial adulticide application monitoring of cranberries in designated spray areas.

Certified Organic Farms
MDAR will exclude all certified organic farms from aerial applications of adulticides, even under a declared emergency or certification of public health hazard signed by the Commissioner of MDPH that aerial application is necessary to protect the public. MDAR has worked with certifying organizations to identify certified organic farms, and to map these farms. Mapping of all certified organic farms is an ongoing process, updated annually, and being done statewide.

The USDA National Organic Program (NOP) does not prohibit the application of pesticides for a public health emergency on certified organic farms (*see Section 205.672 Emergency pest or disease treatment of the National Organic Standards*). However, any harvested crop or plant part to be harvested that has contact with a prohibited pesticide cannot be sold, labeled, or represented as organic. Organic farms sprayed with pesticides as part of a public health emergency do not lose their certification, only the ability to market the current year's crop as organic. MDAR believes that this exclusion will have an insignificant impact on the efficacy of the spray operation. Certified organic farms are not prime habitat for mosquitoes and represent an extremely small area of land. Exclusion is necessary to protect the certification of the farm. As such, the risk benefit analysis favors exclusion. There is no need to exclude transitional farms (Tfs) from spraying under the NOP. However, those Tfs that make known their status will be excluded. Transitional farms are those farms undergoing the process of becoming certified as organic. Under the NOP, when applications are conducted for public health purposes, there is no impact on the status of transitional farms or the timeline under which they become certified.

Creation of the Geographic Data for Aerial Adulticide Spray Operations

The MDPH-BLS and MDPH-BEH will make available a GIS polygon indicating the geographic area where human risk of EEEv or WNv may warrant aerial adulticiding efforts to all agencies that are involved with the Commonwealth's mosquito control efforts. This GIS polygon will be circulated via email within 5 hours of its definition. Concurrently, hard-copy maps of the polygon will also be reviewed by MDPH/BLS using standard departmental cartographic templates and language and posted at the MDPH website.

The development, maintenance, sharing, and general stewardship of potential GIS data layers that demarcate areas that are sensitive to aerial spray operations, is the responsibility of the GIS staff in the agencies with respective authority for the these aerial spray sensitive areas. For example, the MDEP is responsible for the maintenance and provision of open water polygons that have been identified as spray sensitive areas. Similarly, certified organic farms and commercial aquaculture facilities are the responsibility of MDAR GIS staff as are priority habitats the responsibility of the DFG NHES program. Prior to the mosquito season, agencies will create and maintain thematic GIS layers of areas that are sensitive to aerial adulticide spray operations and update these as appropriate. The release by MDPH of the GIS polygon indicating areas of high human risk of EEEv will be followed by the inclusion of aerial spray sensitive data layers from each agency within the designated polygon. The MDPH polygon and spray sensitive areas will be compiled by a GIS point person at MDAR and re-circulated to DEP and DFG within 24 hours. Each agency must approve in writing (e.g., via email) to the GIS point of contact at MDAR as to the accuracy of the delineation of the areas of high human risk and spray sensitive areas. After consensus, MDAR will send the final geographic data to the aerial applicator for conversion to appropriate navigational formats.

Mosquito Response Plan Funding and Costs

The cost of an emergency aerial intervention will be dependent on conditions identified as the mosquito season progresses, which includes but is not limited to the number of acres needing treatment, the kind and amount of chemical necessary to cover the area of risk, calibrating and characterization of delivery apparatus of aircraft, environmental

monitoring expenses, aircraft software (AGNAV) and Mapping Tech support, post-spray analysis, personnel expenses, and established contingency contracts for aerial application services.

Table 1: Summary of Operational Response Plan Responsibilities

MDPH Risk Category	MDPH	SRMCB
1- Remote	1. Standard surveillance activities. 2. Provide educational materials to the general public on personal prevention steps and emphasizing residential source reduction 3. Emphasize need for schools to comply with MA requirements for filing outdoor IPM plans 4. Conventional collection and testing of mosquitoes. 5. Passive human and horse surveillance 6. MDPH Epidemiological staff provide educational materials and clinical specimen submission protocols to targeted groups involved in arbovirus surveillance (including local boards of health, physicians, veterinarians, animal control officers, stable owners, etc.	Standard mosquito practices for monitoring and surveillance. Carry out Best Management Practices (BMPs) such as Integrated Pest Management (IPM) to reduce immature and adult mosquitoes. Maintain larvicide applications (where necessary) at designated sites; and adulticide applications based on Mosquito GEIR and GEIR updates, MCPs surveillance, and other relevant data.
2- Low	Response as in category 1, plus: 1. Expand community outreach and public education programs, particularly among high-risk populations, focused on risk potential and personal protection, emphasizing source reduction.	Maintain larval control (where necessary when surveys or monitoring indicates need. Maintain adulticide applications based on Mosquito GEIR, MCPs surveillance, and other relevant data.
3- Moderate	Response as in category 2, plus: 1. Supplemental mosquito trapping and testing in areas with positive EEEV findings. Notify all boards of health of positive findings. 2. Public health alert sent out by MDPH in response to first pool of EEE virus positive mammal-biting mosquitoes detected during the season. The alert will summarize current surveillance information and emphasize personal prevention strategies. 3. HHAN (Health and Homeland Alert Network) alerts are sent to local boards of health upon confirmation of EEE virus in any specimen; health care facilities are advised of increased risk status and corresponding need to send specimens to SLI for testing.	Target Larviciding (if feasible) and adulticiding (where needed) at local municipal level including but not limited to multiple treatments via ground based truck mounted Ultra-Low-Volume (ULV) equipment depending on mosquito abundance and weather conditions.

MDPH Risk Category	MDPH	SRMCB
4- High	Response as in category 3, plus: 1. Intensify and expand active surveillance for human cases. 2. Local officials should evaluate all quantitative indicators mosquito including population density and time of year and may proceed with focal area aerial adulticiding. **3**. MDPH will confer with local health officials, SRMCB and Mosquito Control Projects to determine if the risk of disease transmission threatens to cause multiple human cases and warrant classification as level 5. 4. Intensify public education on personal protection measures including avoiding outdoor activity during peak mosquito hours, wearing appropriate clothing, using repellents and source reduction. a. Utilize multimedia messages including public health alerts from MDPH, press releases from local boards of health, local newspaper articles or cable channel interviews, etc b. Encourage local boards of health to actively seek out high-risk populations in their own communities (nursing homes, schools, etc.) and educate them on personal protection c. Increased advisory information on pesticides provided by MDPH- BEH d. Urge towns/schools consider rescheduling outdoor events.	Continue response as in Category 3 and expand or intensify where needed or around positive virus findings, location of residents near positive findings, type(s) of wetland habitat to target where treatment would be most effective. MCP's/BOH/local officals may proceed with focal area aerial adulticiding in order to suppress risk in these areas. The SRMCB considers "focal area" to include but not be limited to a multiple mile radius circle or larger around positive virus findings that could incorporate multiple communities, towns or cities. The delineation of a focal area at risk depends on a number of factors such as prior year isolations, timing of current virus isolations as well as the species of mosquitoes where virus is confirmed, location and density of residents near positive findings, type(s) of wetland habitat to target where treatment would be most effective, general mosquito habitat, and the cyclical and seasonal conditions that represent conditions conducive to risk of human disease Confer with MDPH and local health officials and determine if classification 5 is warranted. If high health risk is declared, advise respective agency commissioners of appropriate pesticide, extent and route of treatment and targeted treatment areas and advise commissioners whether a more aggressive approach such as aerial application is necessary. When State Commissioners of MDAR, DEP, and DCR agree that aerial adulticide is necessary, MDAR Commissioner notifies Secretary of EOEEA.

MDPH Risk Category	MDPH	SRMCB
5- Critical	Response as in category 4, plus: 1. The MDPH Arbovirus Program will determine human risk levels as outlined in this plan. If risk of outbreak is widespread and covers multiple jurisdictions, MDPH will confer with local health agencies, SRMCB and Mosquito Control Projects to discuss the use of intensive mosquito control methods and determine if measures need to be taken by the agencies to allow for and assure that the most appropriate mosquito control interventions are applied to reduce risk of human infection. These interventions may include state-funded aerial application of mosquito adulticide. Factors to be considered in making this decision include the cyclical, seasonal and biological conditions needed to present a continuing high risk of EEE human disease. 2. MDPH Bureau of Environmental Health (BEH) will initiate active surveillance via emergency departments and with health care provides only if aerial spraying commences. 3. MDPH will designate high-risk areas where individual no spray requests may be preempted by local and state officials based on this risk level. Aerial adulticiding will override no-spray requests. If this becomes necessary, notification will be given to the public including those who have opted out. 4. MDPH recommends restriction of group outdoor activities, during peak mosquito activity hours, in areas of intensive virus activity. 5. MDPH will communicate with health care providers in the affected area regarding surveillance findings and encourage prompt reporting of all suspect cases.	Continue response as in Category 4. If critical health risk is characterized by MDPH notify respective agency officials of appropriate pesticide, extent and route of treatment, targeted treatment areas and advise commissioners whether full scale adulticide aerial spraying is necessary. Once critical human risk has been identified, the SRMCB will determine the adulticide activities that should be implemented in response to identified risk by providing advice relative to: A. Appropriate pesticide B. Extent and route of treatment C. Targeted treatment areas State Commissioners of MDAR, DEP, DCR agree that aerial adulticide is necessary and MDAR Commissioner notifies Secretary of EOEEA. EOEEA Secretary and HHS/MDPH jointly notify Governor. Governor considers advisement to approve declaration of emergency to protect public health risk.

Conclusion

The overall goal of reducing and/or halting the transmission risk of mosquito-borne diseases to Massachusetts citizens during any mosquito season is ultimately achieved by having contracts in place such as aerial application service and insecticide vendor contracts, as well as essential personnel contact lists, and operations plan ready prior to a projected or current mosquito-borne disease outbreak or emergency. These contracts, contact lists, and plan ensure that aircraft, personnel, product, and other supports are available for a rapid and timely response.

This plan assures that the Commonwealth is ready to provide appropriate and, as quickly as practical, the most meaningful response based on entomological, epidemiological, meteorological, and ecological data backed up by both practical and scientific evaluation of this data by the MDPH-BLS, MDPH-BEH, SRMCB, MAG, and other state agencies such as MDAR, DCR, DEP, and DF & W.

Appendices

- Appendix 1: SRMCB Response Matrix to Prevent or Suppress Mosquito-Borne Disease
- Appendix 2: Chain Of Command Flow Chart
- Appendix 3: SRMCB Massachusetts Mosquito Control Surveillance Protocol For Evaluation of Efficacy of Aerial Adulticide Application(s) Regarding Mosquito-Borne Disease
- Appendix 4: Aerial Application and Insecticide ANVIL 10+10 Information Sheet
- Appendix 5: Water Quality Sampling for Mosquito Control Aerial Chemical Application
- Appendix 6: Honeybee Monitoring Protocol for Aerial Mosquito Adulticide Application
- Appendix 7: Memorandum-Biomonitoring of Anvil 10+10 Aerial Spray Impact
- Appendix 8: Water Supply Monitoring Plan to Assess Potential Impact of Mosquito Control Spraying During Any Public Health Emergency To Drinking Water
- Appendix 9: Monitoring the effects of aerial applications of adulticide insecticides on state listed invertebrates
- Appendix 10: Certified Organic Farms List
- Appendix 11: Commercial Freshwater Fish Farm List
- Appendix 12: Bee Keeper Association Notification Tree Contact List
- Appendix 13: Contacts for Conducting Control of Adult Mosquitoes (Vector Species)
- Appendix 14: 2012 Mosquito Advisory Group (MAG) Members
- Appendix 15: 2012 Massachusetts Arbovirus Surveillance and Response Plan

Appendix 1: SRMCB Response Matrix to Prevent or Suppress Mosquito-Borne Disease[1]

ACTION	RESPONSIBLE AGENCY	OBJECTIVE	TIME-FRAME
Conduct surveillance (*Avian such as dead birds, native, exotic, and farmed birds such as emus, mosquitoes, veterinary such as horses, ponies, alpaca etc., and human*)	MDPH-BLS	- To trap, sort, and identify mosquitoes in the field at long-term sites; - To test submitted Dead Birds from Cities/Towns; - To obtain Data from Veterinarians; and - To obtain Clinical Data from Physicians/Hospitals.	June 1 through October 15th
Conduct standard or supplemental surveillance (*mosquitoes*)	MCPs/SRMCB	- To collect and submit mosquito pools to MDPH-BLS for virus detection from non MDPH-BLS sites; - To monitor and report on abundance or trends for both immature and adult mosquito population in local geographic area; - To monitor local climate and weather data; and - To provide weekly trap data.	June 1 through October 15th
Process and report laboratory analyses results	MDPH-BLS	- To perform screening and confirmatory testing of collected specimens (dead birds, mosquitoes, horse, humans etc.); - To maintain and transmit laboratory results via an Arbovirus software system to MCPs; - To distribute weekly arbovirus report regarding laboratory results and confirm positive isolations of EEEv and/or WNv to SRMCB and MCPs and MAG; and - To notify Boards of Health using the Health and Homeland Alert network (HHAN) to report human and equine/mammal case information and mosquito results.	June 1 through October 15th
Characterize severity of human risk	MDPH-BLS	- To evaluate **current level of risk** geographically based on triggers outlined in the **MA Surveillance and Response Plan.**	June 1 through October 15th
Communicate severity of human risk to public	MDPH Office of Public Health Strategies and Communication	-To provide Guidance and Alerts to BOHs, general public, and media on ways to reduce risks.	June 1 through October 15th
Analyze, evaluate, and scrutinize all available data from MDPH-BLS and MCPs	MAG	- To advise SRMCB concerning mosquito control intervention(s) necessary to prevent or reduce human risk ***before*** it becomes significant or spreads. - To advise SRMCB of surveillance and intervention strategies ***during*** periods of elevated risk.	Ongoing – May 15th to October 15th

[1] See Agency Key on Page 24.

NOTE: Due to the complexity of operations to prevent or suppress mosquito-borne disease, actions outlined in this matrix may be implemented concurrently or simultaneously in order to achieve the objectives. Moreover, the actions outlined, responsibilities, and associated time-lines may be subject to change without notice.

ACTION	RESPONSIBLE AGENCY	OBJECTIVE	TIME-FRAME
Submit summary report(s)	SRMCB/MDAR	- To inform and advise SRMCB respective state agencies commissioners and EOEEA key personnel of arbovirus risk status and mosquito control response intervention being taken (if any).	Beginning when virus is first confirmed and Bi-weekly from July 15st-September 30th
Advise respective state agency stakeholders when necessary	SRMCB, MAG, and MDAR	- To determine what mosquito control intervention will be most effective to **prevent or suppress** potential for human risk including but not limited to maintain standard mosquito and virus surveillance activities, increase mosquito and virus surveillance activities, intensify and increase localized control of immature (where practical) and/or adult mosquitoes, and/or accelerate, expand, and target control of adult mosquitoes in larger geographical areas.	Ongoing – May 15th to October 15th Or when virus is confirmed
Review, select and approve insecticide or product of choice	MDPH, BEH, DEP, MDAR,SRMCB	- To prepare and collaborate to select and approve the specific pesticide product to be used; and - To file and obtain Federal authorization to use a pesticide not registered for use over crops.	Ongoing-January 1st to December 31st
File application to EPA for public health emergency exemption (if required)	MDAR/ SRMCB	- To file and obtain Federal authorization to use a pesticide not registered for use over crops.	Ongoing-January 1st to December 31st
Direct MCPs to respond locally	SRMCB	- To adjust, increase, or maintain standard mosquito surveillance and control activities to **prevent or suppress** potential for human risk.	Ongoing – May 15th to October 15th Or when virus is confirmed
Classify risk as Level 5 or (Critical)	MDPH-BLS	. The MDPH Arbovirus Program will determine human risk levels as outlined in this plan. If risk of outbreak is widespread and covers multiple jurisdictions, MDPH will confer with local health agencies, SRMCB, and MCPs and MAG to discuss the use of intensive mosquito control methods and determine if measures need to be taken by the agencies to allow for and assure that the most appropriate mosquito control interventions are applied to reduce risk of human infection. These interventions may include state-funded aerial application of mosquito adulticide. Factors to be considered in making this decision include the cyclical, seasonal and biological conditions needed to present a continuing high risk of EEE human disease. Once critical human risk has been identified, the SRMCB will determine the adulticide activities that should be implemented in response to identified risk by providing advice relative to: A. Appropriate pesticide B. Extent and route of treatment C. Targeted treatment areas MDPH- (BEH) will initiate active surveillance via emergency departments and with health care provides only if aerial spraying commences	June 1 through October 15th

ACTION	RESPONSIBLE AGENCY	OBJECTIVE	TIME-FRAME
Notify respective state agency Commissioners of Level 5 (Critical) classification	SRMCB and MDAR	- To advise SRMCB respective state agencies commissioners. MDAR Commissioner notifies EOEEA Secretary when highest level of risk has been characterized by MDPH-BLS for purpose of considering the most effective interventions to **prevent or suppress** human risk including but not limited accelerating, expanding, and targeting adult mosquitoes in larger geographical areas such as aerial application.	Concurrent with virus characterization and mosquito control advice
Classify risk as Level 5 or (Critical) cont'd.	MDPH-BLS, MDPH-BEH, MDAR, SRMCB, MAG, and DF& W	- To initiate emergency conference calls and meetings with multiple state agency stakeholders including but not limited to MDPH-BLS, MDPH-BEH, DAR, SRMCB, MAG, DF&W in order to reach consensus on most effective way to **prevent or suppress** human risk including but not limited accelerating, expanding, and targeting adult mosquito control in larger geographical areas such as aerial spray. SRMCB will notify respective their state agencies commissioners. MDAR Commissioner notifies EOEEA Secretary regarding emergency conference call(s) and meeting consensus; and to invite Aerial Applicator and Insecticide contractors, and BOHs to participate.	Concurrent with virus characterization and mosquito control advice
Contact emergency aerial applicator and insecticide contractor	SRMCB	- To facilitate the timely deployment of aircraft and pesticides required for an aerial intervention.	Immediately upon multiple stakeholder consensus and before declaration of Public Health Emergency
Notify and advise executive level administrators within State government	MDPH Commissioner's Office and EOEEA Secretariat Office	- To inform and advise of critical mosquito-borne risk level.	Concurrent with virus characterization and mosquito control advice
Notify and advise Governor	MDPH Commissioner's Office and EOEEA Secretariat Office	- To provide joint notification and advisement by MDPH Commissioner, EOEEA Secretary, EHHS Secretary, in order for Governor to consider declaration of public health emergency.	Concurrent with virus characterization and mosquito control advice
IMPLEMENT OPERATION **Send formal authorization to aerial applicator and pesticide contractor**	SRMCB and MDAR	To confirm and formalize communications that authorize both aerial applicator and insecticide contractor to proceed for the purpose of making an aerial mosquito adulticide application over the populated areas identified in specified geographic portions of Massachusetts in response to increased mosquito populations and infection rates of EEEv and WNv on behalf of the Commonwealth of MA and State Reclamation and Mosquito Control Board.	Immediately and concurrently with declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Confirm federal authorization of pesticide product to be used for aerial intervention**	MDAR	- To ensure compliance with state and federal pesticide laws.	Immediately and concurrently with declaration of public health emergency

ACTION	RESPONSIBLE AGENCY	OBJECTIVE	TIME-FRAME
IMPLEMENT OPERATION (Cont'd) **Notify the Federal Aviation Administration (FAA)**	SRMCB	- To complete notification of the FAA that an aerial intervention will be performed; and - To obtain approval to apply insecticides for mosquito control over Congested Areas (CAP) citing geographic area and beginning and end dates of treatments.	Immediately and concurrently with declaration of public health emergency
IMPLEMENT **OPERATION (Cont'd)** **Notify the Massachusetts Aeronautics Commission (MAC)**	SRMCB	- To obtain the certificate of waiver from the Massachusetts Aeronautics Commission (MAC) pursuant to 702 CMR 4.	Immediately and concurrently with declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Forward all approval documents from FAA and MAC to aerial applicator**	SRMCB	- To assure compliance with state and federal aviation rules and regulations.	Immediately and concurrently with declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Notify pre-designated airport for conducting operations**	SRMCB and MDAR	- To obtain approval to use facility as operational site as pre-designated; and - To insure secure site for aircraft and pesticide inventory at airport during operations.	Immediately and concurrently with declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Request Massachusetts Environmental Police Detail**	SRMCB and MDAR	- To provide security for the aerial application operation at the airport.	Immediately and concurrently with declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Establish base of operations**	SRMCB and MDAR	- To supervise the operation and facilitate the communication and decision-making in accord with the operational plans.	Immediately and concurrently with declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Calibrate and characterized spray delivery apparatus**	SRMCB/MDAR and Contractor	- To ensure calibration and characterization of spray delivery equipment in compliance with product labeling and other operational parameters.	Concurrent with time of anticipated treatment
IMPLEMENT OPERATION (Cont'd) **Notify DF&W and DMF in accordance with Fish Impact MOU**	SRMCB and DEP and MDAR	- To follow State Fish Impact Memorandum of Understanding (MOU).	Immediately and concurrently with declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Notify MPAL that samples will be delivered**	SRMCB and MDAR	- To arrange with the University of Massachusetts Pesticide Analysis Laboratory (MPAL) for the analyses of all samples collected pre- and post-application.	Immediately and concurrently with declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Implement Water Quality Sampling**	SRMCB and DEP and MDAR	- To carry out established Water Quality Sampling .	Immediately and concurrently with declaration of public health emergency

ACTION	RESPONSIBLE AGENCY	OBJECTIVE	TIME-FRAME
IMPLEMENT OPERATION (Cont'd) **Activate notification protocols for bee keepers, aquaculture facilities, and certified organic farmers, and honey bees**	SRMCB and MDAR	- To activate the Bee Keeper Association Notification Tree and facilitate communication and provide information on the specific pesticide application operational details to the following previously identified agricultural parties: o Beekeepers; o Aquaculture Facilities; and o Certified Organic Farmers.	Immediately and concurrently with certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Assign MCPs personnel to observe and note aerial application characteristics and weather.**	SRMCB and MDAR	- To have MCPs personnel observe flight paths, pesticide applications, conduct pre and post application sampling of mosquitoes to determine efficacy and evaluate/document weather conditions including wind and temperatures during the applications.	Immediately and concurrently with certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Activate SRMCB efficacy trapping protocol and convene meeting of efficacy-evaluation workgroup**	SRMCB, MDPH-BLS, MAG, and MCPs	- To have **efficacy-evaluation workgroup** confirm trap type, trap placement; target species; and distance from spray perimeter in accordance with the SRMCB Efficacy protocol and review the GIS maps representing the geographic area and habitats encompassed by the spray zone to determine specific trap sites that will be included in the IN/OUT to measure for efficacy evaluation	Immediately and concurrently with certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Establish integrated communication strategy.**	SRMCB and MDAR	- To ensure interoperability of communication equipment such as cell phones, radios, etc. such that all divisions within the operation maintain communication with each other and provide necessary and otherwise important information in a timely manner.	Immediately and concurrently with certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Designate official(s) who will communicate with the aerial pilot.**	SRMCB and MDAR	- To designate state official(s) who will supervise the aerial spray operation and communicate with pilot(s) prior to, during, and after spraying operations	Immediately and concurrently with certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Assign state personnel for on site inspection and monitoring**	SRMCB and MDAR	- To designate state officials, in addition to contractor personnel, to inspect airplanes and spray equipment, monitor calibration and characterization of droplets, monitor pesticides being loaded into the aircraft.	Immediately and with certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Notify and coordinate activities of Public Relations Office of EOEEA, EHHS, MDPH Office of Public Health Strategies and Communications**	MDAR, MDPH Office of Public Health Strategies and Communications and Contractor PR services	- To insure coordination between Public Relations Office of respective state agency secretariat responsible to conduct media campaign for dissemination of public health risk communication information regarding specific areas that will be treated, timing of application, choice of pesticide, and information to mitigate personal and environmental risks through media outlet electronic fax notification system called BLAST and other means.	Immediately and with certification or declaration of public health emergency

ACTION	RESPONSIBLE AGENCY	OBJECTIVE	TIME-FRAME
IMPLEMENT OPERATION (Cont'd) **Notify media relative to treatment areas**	MDPH Office of Public Health Strategies and Communications and MDAR/SRMCB	- To provide the media with maps detailing treatment areas; - To provide the media with public health risk communication information; - To provide the media with information relative to the choice of pesticide to be used, the time of applications, and information to help mitigate environmental health risks in the specific towns to be treated; and - To make the above information also available via the state websites maintained by MDPH and DAR.	Immediately and with certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Notify local Police Departments in treatment areas**	SRMCB and MCPs	- To help prepare local Police Departments in treatment areas; such that, they are aware of the spray operation to occur in their community and are able to direct individuals calling them to the State's informational resources via established informational hotlines, websites, etc.	Immediately and concurrently with certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Notify Local Boards of Health in designated treatment areas**	MDPH-BLS	- To notify Local Boards of Health in designated treatment areas utilizing the Health and Homeland Alert Network (HHAN); such that, they are aware of the spray operation to occur in their community and are able to direct individuals calling them to the State's informational resources via established informational hotlines, websites, etc.	Immediately and concurrently with certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Develop and Send final GIS mapping shape file data to SRMCB**	MDAR	- To compile and develop the final comprehensive GIS maps with all exclusion zones delineated to EOEEA agencies such as DAR/SRMCB, DFW, DEP and DCR for consensus and approval; and - To allow for the SRMCB to provide the GIS maps to the aerial applicator/contractor no later than 48 hours prior the commencement of operation for navigation software preparation.	Immediately and concurrently with certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Follow up to Ensure that GIS maps for aerial intervention are complete for operations**	SRMCB	- To ensure final GIS shape file maps with the required exclusion zones and buffer zones for the specified treatment areas have been forwarded to aerial application service vendor in order to ensure pilot/aircraft navigation systems via AGNAV software uploaded in timely manner.	Immediately and concurrently with certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Obtain additional assistance from CDC to assist in aircraft and insecticide set up if necessary**	SRMCB	- To obtain additional assistance from CDC to assist in aircraft and insecticide set up **(if necessary).**	Immediately and concurrently with certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Implement active surveillance of potential health effects in area of treatment**	MDPH-BEH	- To activate and implement active surveillance of potential health effects in area of treatment	Immediately and concurrently with d certification or declaration of public health emergency
IMPLEMENT OPERATION (Cont'd) **Identify media Public Information Office (PIO)**	MDPH Office of Strategies and Communications and MDAR/SRMCB	- To identify media Public Information Office (PIO), establish media center, and disseminate pre-prepared media kits	Immediately and concurrently with certification or declaration of public health emergency

ACTION	RESPONSIBLE AGENCY	OBJECTIVE	TIME-FRAME
IMPLEMENT OPERATION (Cont'd) **Activate SRMCB surveillance protocol to evaluate efficacy**	SRMCB and MDAR	- To activate surveillance protocol surveys in addition to MCP tasks within spray areas and in areas outside of the sprayed area for comparison purposes.	Upon completion of all other necessary logistical steps and cooperation of conditions supporting applications.
IMPLEMENT OPERATION (Cont'd) **Commence Aerial Adulticide Spraying Operation (weather dependent)**	SRMCB and Contractors	- To commence Aerial Spraying Operation	Upon completion of all necessary logistical and operational preparatory steps and cooperation of conditions supporting applications.
ASSESS OPERATION	SRMCB	Provide 1-2 page summary report to respective state agency commissioners and other key state agency stakeholders Provide report of Intervention including but not limited to final number of acres treated, per cent efficacy results, environmental impairment sampling results, complaints, etc.	Complete Brief Summary Report within two weeks or as soon after operation as practical Complete final report within six months of receipt of all documentation and data analysis from operation.

Key to Massachusetts Agency Names:

BOH = (Local) Boards of Health;

EOEEA =Executive Office of Energy and Environmental Affairs;

EHHS = Executive Office of Health and Human Services;

DFG= Division Fish and Game;

DFW = Division Fisheries and Wildlife;

DMF = Division of Marine Fisheries;

MAG = SRMCB Mosquito Advisory Group;

MCPs = Regional Mosquito Control Projects;

MDAR= Department of Agricultural Resources;

MDPH-BEH = Massachusetts Department of Public Health, Bureau of Environmental Health;

MDPH-BID = Massachusetts Department of Public Health, Bureau of Infectious Diseases;

MDPH-BLS = Massachusetts Department of Public Health, Bureau of Laboratory Sciences;

SRMCB = State Reclamation and Mosquito Control Board.

Appendix 2: Decision-Making Flow Chart

The Response Matrix or operational response is activated when MDPH issues a finding that there is a risk to the public health from mosquito arbovirus (level IV or V according to most current MDPH's Arbovirus State Surveillance and Response Plan) and when MDPH along with the MAG advise for risk reduction interventions. At that point, depending on the location(s) and extent of the problem, the type of virus involved and a number of other variables, a decision will be made by the SRMCB and the individual MCPs as to what specific measures will be implemented. As noted above, the Mosquito Advisory Group (MAG) will be asked for scientific advice based on specific current conditions. Because at any time, there are many data under review and there are many individuals and organizations that must be involved during a short time period to protect the public health, this appendix outlines the key components and responsible agency in the decision-making process expectations. Decisions and actions by each agency require a transparent and expedient process to ensure that efforts are justified and swiftly performed.

Ongoing seasonal mosquito data collection and monitoring (MDPH-BLS and SRMCB and MCPs)

↓

MCPs under aegis of SRMCB standard, locally established mosquito control efforts including targeted ground adulticiding operations based on Mosquito GEIR, MCPs surveillance data and MDPH (SLI) trapping data when risk classification is low to moderate.

Ongoing seasonal analysis and evaluation of long-term trapping data (MDPH-BLS)

↓

MDPH/BID-BLS will characterize human risk severity level and delineate the spray area with a GIS map based on arbovirus surveillance data.

↓

MDPH/BID requests permit from DFW for treatment of priority habitat to be issued to MDAR

↓

MDAR coordinates multi-agency GIS mapping and develops final shape files for SRMCB

↓

MAG will review and evaluate MDPH long-term trapping data along with other data such as MCPs data and provide advice to SRMCB

↓

SRMCB will advise its respective state Commissioners representing MDAR, DEP, & DCR who notify EOEEA officials on most meaningful intervention action to protect public health from mosquito-borne disease

↓

Spray Decision certified for public health purpose by MDPH Commissioner and/or Governor's Office declares public health emergency

↓

Commence and Supervise Aerial Adulticide Operation (SRMCB/ MCPs/MDAR)

↓

Feedback/Assessment of operation (MCP, SRMCB, MDPH and MAG)

Appendix 3: SRMCB Massachusetts Mosquito Control Surveillance Protocol for Evaluation of Efficacy of Aerial Adulticide Application(s) Regarding Mosquito-Borne Disease

INTRODUCTION

Eastern Equine Encephalitis (EEEv) and West Nile Virus (WNv) are the most significant mosquito-borne public health threats in Massachusetts. In Massachusetts and elsewhere in the United States, established regional mosquito surveillance and control programs operate using the principles of, Integrated Pest Management (IPM), or more specifically, Integrated Mosquito Management (IMM). A basic tenet of IPM and IMM is that action thresholds and intervention decisions are based on surveillance.

Mosquito-Borne disease surveillance demands proper pest recognition and quantification as it defines the local epidemiology of the disease: the presence, distribution, and prevalence of the causal agents and vectors. Surveillance of these populations, along with careful scrutiny of environmental influences, seasonal variations, facilitates the process of assessing risk of mosquito-borne disease, and provides a basis for intervention decisions.

In Massachusetts, the State Reclamation and Mosquito Control Board (SRMCB) and the mosquito control districts/projects (MCPs) collaborate with the Massachusetts Department of Public Health (MDPH) Arbovirus program to monitor ecological and epidemiological parameters, and to dynamically assign risk levels pertaining to EEEv and WNv transmission throughout any mosquito season.

PURPOSE

This document establishes a standardized protocol for use by SRMCB, MCPs and MDPH. The purpose of this protocol is to provide guidance on how to quantitatively document the impact of aerially applied adulticide on mosquito populations. The goal of the intervention is to reduce the risk to humans of contracting a mosquito borne disease.

Although the protocol places emphasis on EEEv, there is an established surveillance system for WNv. The WNv surveillance system uses different mosquito traps (gravid traps) than the EEEv program. The gravid trap collects live *Culex* adults (primary vector of WNv) for virus analysis and could be used to quantitatively measure the efficacy of WNv interventions such as aerial adulticide application.

LESSONS LEARNED AND CHALLENGES DURING 2006 and 2010

During the 2006 and 2010 mosquito season, state arbovirus surveillance data overwhelmingly indicated that the use of aerial adulticiding to large areas of Southeastern Massachusetts would be a prudent intervention to curtail a dramatic increase in the mosquito-borne threat of EEEv. In response to these elevated arbovirus risk events, establishing suitable pre- and post- monitoring locations proved a significant challenge. The discrepancies and variability of the measured reductions in mosquito abundance observed in 2006 and 2010 were likely attributable to differing methods of

analysis as well as confounding factors such as unforeseen weather conditions between pre and post collections, terrain, locations and kind of traps utilized, and mosquito species.

The experience of two significant aerial operations revealed the need for an improved aerial application efficacy results protocol incorporating as much standardization to the extent feasible that could address as many of the aforementioned variables and complexities inherent in the sampling of adult mosquitoes prior to and post aerial application. These inherent complexities include, but are not limited to, flight range of the target mosquitoes being sampled, selection of trap sites appropriate for assessing efficacy, and limitations in personnel and resources to document age structure. The current protocol would be improved overall by identifying sites where standard mosquito trapping equipment might be set prior to any decision to embark upon a wide scale aerial intervention.

During 2006 and 2010, additional or supplemental resources were not available to conduct efficacy measures for the aerial intervention. The same MCPs and MDPH personnel were responsible for several tasks including routine seasonal surveillance for evaluating mosquito abundance, submission of collections for virus testing, data collection entry efforts and performing emergency and high risk arbovirus intervention tasks which required setting additional traps in order to be able to measure the efficacy of the aerial adulticide intervention. This is critical to determine if the intervention was successful for the purpose of making conclusions that virus transmission dynamics was impacted or interrupted.

There was no established timeline between SRMCB, MCPs, and MDPH regarding the turnaround time pertaining to how long the efficacy analysis, interpretation, and resulting reports would take and be available to decision makers. This revised protocol will serve to insure that all parties involved with aerial application efficacy results are familiar and prepared pertaining to the actual mechanics of the trapping task including but not limited to the number of traps that should be used pre and post aerial operation, the particular trap needed, and the acceptable ranges for placement within and outside of spray zone perimeter. Once relevant data from these collections has been provided, the SRMCB and MDPH shall determine the final efficacy results for reporting purposes. Serious efforts to objectively measure efficacy must be supported by appropriate personnel and resources.

Due to the nature of an elevated arbovirus risk event such as those in 2006 and 2010, unpredictable weather conditions, and logistical uncertainties present communication obstacles. These include not knowing in advance the number of aircrafts that would be available and the size and order of priority pertaining to spray zones and blocks. All parties involved with aerial application efficacy results need to meet or conference by telephone during the mosquito season when mosquito abundance and/or arbovirus activity warrants the above. As a result, this important communication will reduce the challenges including but not limited to enhancing past less than desirable notification pertaining to the proposed spray areas and operational updates during any aerial spray.

In 2010, the aerial operation was postponed on the first night due to inclement weather, requiring an additional night of pre-monitoring to take place. This increased the amount of supplies, specifically CO_2 necessary to monitor the sites.

In 2010, MCPs and MDPH were able to use designated sensitive areas excluded during the 2006 aerial intervention anticipating that these locations would not be proper trap placements for evaluating treatment site trap locations. This was an improvement over the 2006 application when previously environmentally sensitive areas were unknown. Another challenge during the 2010 intervention did not know in advance the treatment blocks or spray zones that would be sprayed first within the established risk polygon. Prior mosquito sampling and virus isolations used to determine the need for an application should show the areas of highest priority, which are most likely to be sprayed on the first night. These factors should be taken into consideration when determining treatment trap sites. Finally, an additional unknown factor is where a treatment block will begin or end, creating a situation where some traps could be set too close to the edges between spray nights, which will have a major impact on efficacy calculations.

In summary, the more standardized the sampling protocol, the easier and more accurate the aerial application efficacy results. The experience gained during the elevated arbovirus risk events in 2006 and 2010 especially communication between SRMCB, MCPs, and MDPH will lead to better interpretation and application of the data derived from sampling efforts to assess efficacy of an aerial application intervention. Decisions and actions by each agency require a transparent and expedient process to ensure that efforts are justified and swiftly performed.

SPECIFIC SPECIES OF MOSQUITOES

More than 150 species of mosquitoes have been identified in the U.S.; of these, 51 are known to occur in Massachusetts. Differences in behavior and lifecycles allow these species to utilize different niches. All mosquitoes require water in which their immature stages develop however, each species of mosquito exploits a characteristic habitat (e.g. fresh water wetland, salt marsh, cedar swamp, tree hole, etc). The number of generations produced is species dependent. A given species may have just one generation each year or it may have several. The timing of these generations is also species dependent for example many species have one generation each spring whereas other species may have one generation in mid-summer. Different mosquito species also quest for blood at different times of the day (e.g. daytime, nighttime or during dawn/dusk periods). Furthermore, mosquitoes of certain species feed predominately on one kind of host (e.g. birds or mammals), whereas others are less discriminating and feed on a number of different ones. Because of these and yet other differences, certain kinds of mosquitoes are better able to acquire, maintain and transmit disease-causing viruses between their vertebrate hosts. Accordingly, just a few kinds of mosquitoes are of particular concern to public health authorities and the mosquito control in Massachusetts. For EEEv, these include the maintenance vector *(Culiseta melanura*), and the likely bridge vectors (mainly *Aedes vexans, Ochlerotatus canadensis, and Coquilletidia perturbans).* For WNv virus, these include the maintenance vector *(Culex pipiens)*, and a long list of potential bridge vectors.

QUANTITATIVE MEASUREMENT FOR EFFICACY OF AERIAL APPLICATION OF PESTICIDES

Traps used for assessing the efficacy of an adulticidal application generally should be selected and deployed to maximize the sampling of mosquitoes of the target species. The larger the sample size, and the greater the proportion of the sample being composed of the target species, the greater the return on investment of time and labor. The efficacy of an EEEv or WNv intervention can be measured in three ways.

1. One measure documents changes in the abundance of mosquitoes.
2. The second measure documents changes in the infection rate of the mosquito population.
3. The third measure documents changes in the age structure of the population (older mosquitoes are more likely to carry disease). Generally some combination of these methods should be used.

Changes in the Abundance of the Mosquito Population

Documenting a decrease in mosquito abundance is done by comparing populations before and after the application. Decreases in mosquito abundance support a conclusion that the intervention was successful since the likelihood of humans acquiring bites by disease carrying mosquitoes has been reduced. This analysis of efficacy takes into consideration changes in the abundance of mosquitoes (pre- and post- application) in non-treated areas. The number of mosquitoes collected in a trap can vary significantly for a variety of reasons that have little to do with the efficacy of the application. In some cases mosquito abundance may even be observed to rise after a spray event. Such phenomena may be explicable on the basis of weather, the emergence of new adults and immigration of mosquitoes from beyond the treated area. Comparison of untreated areas with treated areas helps to account for these influences on collections. Comparing abundance before and after a spray event is the primary method for determining the efficacy of the application.

These calculations are done using Abbott's formula (Abbott, 1925):

X= the percent living in the control area
Y=the percent living in the treated area

((X-Y)/X)*100=percent control

Changes in the Infection Rate of the Mosquito Population

Efficacy can also be measured by calculating changes in the minimum infection rate. The minimum infection rate (MIR) is an estimate of the number of mosquitoes in the environment that are infected with the virus. The number is calculated from the number of mosquitoes tested and the number of positive pools. (# of positive pools/total # tested)*1000 = MIR

MIR is usually expressed as the number of infected mosquitoes per 1,000 mosquitoes. An effective intervention should be expected to reduce the MIR post treatment, relative to the MIR pre-treatment. A conclusion based solely upon the MIR results (absent data pertaining to the corresponding abundance and population age structure) may compromise the level of assurance of any conclusion. An increase in the MIR post treatment might be suggestive of an intervention failure, or be explicable to a decrease in the abundance of young mosquitoes that had less opportunity to have acquired infection.

Changes in the Age Structure of the Mosquito Population
The third method to determine efficacy documents changes in the age structure of the mosquito population. Mosquitoes infected with WNv or EEEv are mosquitoes that have blood fed at least once. In most cases this also means that they have laid eggs. The development of eggs causes changes in the ovarian tracheoles. These changes can be seen through dissection (Detinova et al, 1962). After a successful application parity rates should decrease. Examining parity rates can help document the emergence of new mosquitoes. This method has not been employed in Massachusetts because of the resources needed. These resources include additional traps, trained personnel, and time. All of these resources are in short supply during an aerial intervention. The dissections also potentially decrease the number of mosquitoes that can be tested for disease.

TRAP TYPES

Diverse kinds of traps exist for the surveillance of adult mosquitoes. Each kind of trap has attributes that make it more or less useful than other kinds for sampling certain kinds of mosquitoes.

In Massachusetts, the traps used most often for surveillance of adult mosquitoes includes the *CDC light trap, the ABC light trap, the UV light trap, the gravid trap, the New Jersey Light trap, BG-Sentinel and the resting box.*

The *CDC trap* was first designed in the late 1950's by the Centers for Disease Control. The trap is compact and portable, is powered by a battery, and can maintain sampled mosquitoes alive for the purpose of species identification and viral assay. A small incandescent lamp disorients flying insects, and a fan draws these into a collection chamber. The light may be augmented or replaced by a carbon dioxide (CO_2) source. Several modifications to the basic design are available; each configuration changes the attractiveness of the trap to different kinds of mosquitoes. Modified versions in use in Massachusetts include the American BioPhysics (ABC) trap (used by the Plymouth County Mosquito Control Project), and the UV light trap (used by MDPH and Bristol County Mosquito Control Project), which is fitted with a blue-black light rather than the standard incandescent lamp. *UV light traps* can be deployed as a CO_2 or non-CO_2 option.
Mosquitoes are attracted to the black light and collect similar species and numbers as the CDC light trap. If used to determine efficacy, collection data derived from UV traps operating in treated areas should be compared to data from UV traps operated in non-treated areas. The use of the UV trap to analyze efficacy for the purpose of this protocol

is not recommended since the numbers of mammal biting mosquitoes may be under represented by lack of CO_2 bait.

Carbon dioxide (CO_2) may be provided by a mass of sublimating dry ice, or as a metered flow from a pressurized cylinder. Standard use of a calibrated metered flow aids in comparing results between trap collections. This trap, baited with a CO_2 source, attracts the widest cross section of an existing, host seeking population. Generally, mosquitoes represent the largest fraction of insects collected within CDC traps. The primary enzootic vectors of EEEv (*Culiseta melanura)* and WNv (*Culex species*) are readily sampled with these devices. Currently, the CDC Trap (even with the modified versions mentioned above augmented with CO_2) is the most efficient or best standard surveillance device for assessing the efficacy of an aerial application because of its relatively low cost, portability, widespread use, and tendency to maintain captured insects alive and in good condition.

The *Gravid Trap* is used almost exclusively to collect female *Culex pipiens and Cx. restuans* that have already taken a blood meal and are seeking a site to deposit eggs. These portable battery-operated traps are particularly useful for surveillance of virus-infected mosquitoes because they tend to collect the older (and thus infected) portion of the vector populations, and maintain the captured mosquitoes alive and in good condition for laboratory assay. Gravid traps, therefore, are valuable for WNv monitoring efforts.

The *New Jersey Light Trap* is a large, robust device powered by 120V AC. Consequently, these are best deployed as permanent installations. These may be modified by substituting carbon dioxide for light, also released in a metered flow from a pressurized cylinder. Since the NJ traps are connected to an AC power source, electrical seven-day timers can be connected to these traps, allowing for automatic timed collections. Several collections per week can now be realized with trap visits limited to only collections and maintenance since the traps are set permanently for the duration of the season. The main drawback is that traps can only be set in habitats with easy access to electrical power. Because they are not as portable as CDC traps, they are less suitable for rapid deployment in temporary sites.

The *BG-Sentinel* traps are devices that have been shown to attract the Asian Tiger Mosquito (ATM), *Ae. albopictus*, more than other traps currently used in surveillance by regional programs. Its design and use of a lure that mimics substances found on the human skin provided for a more effective trapping and monitoring tool for species such as *Ae. albopictus*. Originally developed to collect *Aedes* species for surveillance of arboviruses such as yellow fever and Dengue, it has shown to be the most efficient at collecting human-biting mosquitoes. It mimics convection currents created by a human body, employs attractive visual cues, and releases an attractant through a large surface area. Although ATM or *Ae. albopictus* is not known to be established in MA, it has been collected in the south coast of Bristol County in 2000, 2009, 2010 and 2011.

The *Resting Box* is used almost exclusively to sample adult *Culiseta melanura, particularly those that have already blood fed*. Because few other kinds of mosquitoes or insects visit such boxes, this surveillance device tends to be a selective and sensitive indicator of EEEv transmission in the immediate area. Resting Boxes, require very little

maintenance, no bait or power source necessary, and depending on construction material (from fiber pulp to plywood), they can be used for many years. Arrays of resting boxes are operated in focal areas by some MCPs. Because resting boxes generally tend to sample relatively few mosquitoes, the sample sizes may not be sufficiently robust for statistical analyses. Accordingly, they will not routinely be relied upon for evaluating efficacy of aerial applications of pesticides.

Each species of mosquito exhibits its own specific host seeking preferences. These preferences relate to, amongst other characteristics, the kind of hosts attacked, the habitats where they are most abundant, their vertical distribution (for questing, resting and ovipositing), the seasonality of their population dynamics, and their photoperiodicity (for questing and ovipositing). For instance, females of *Ochlerotatus trivittatus* tend to feed under tree canopies, whereas those of many tidal wetland *Ochlerotatus* species seek hosts in open fields. Vertical stratification of host-seeking behavior has been demonstrated, with several species (*Culiseta melanura*, *Culex restuans*) most frequently feeding high in the tree canopies. To assure standardization of trap placement in emergency efficacy evaluations, traps shall be suspended at a height of about 4 feet off the ground.

MOSQUITO IDENTIFICATION AND AGE ASSESSMENT

Correct identification of mosquito vectors is paramount to disease risk assessment and for justifying intervention efforts.

Published 'keys' to assist in identifying mosquitoes include:

1.Connecticut Key: (Andreadis, T.G., Thomas, M. C., Shepard, J. J., Identification Guide to the Mosquitoes of Connecticut 2005, New Haven, CT: The Connecticut Agricultural Experiment Station. 173p.)

2. Midwestern Key: (Siverly, R. E. (1972). Mosquitoes of Indiana. Indianapolis, Ind, Indiana State Board of Health)

3. New York Key: (Means, R. G. (1979). Mosquitoes of New York: Part I. The genus Aedes Meigen, with identification keys to genera of Culicidae. Albany, NY, The University of the State of New York, State Education Dept. State Science Service, New York State Museum and Means, R. G. (1987). Mosquitoes of New York: Part II, Genera of Culicidae other than Aedes occurring in New York. Albany, NY, University of the State of New York, State Education Dept.)

4. Northeastern Key: (Stojanovich, C. J. (1961). Illustrated Key to Common Mosquitoes of Northeastern North America, Stojanovich, Chester J., 750 East McGlincey Lane, Campbell, California 95008).

5. North American Key: (Darsie, R. F., Ward, Ronald A., Chang, Chien C. (1981). Identification and Geographical Distribution of the Mosquitoes of North America, North of Mexico. Fresno, Calif, Fresno, Calif.: American Mosquito Control Association**:** 313p and Darsie, R. F., Ward, Ronald A. (2005). Identification and Geographical Distribution

of the Mosquitoes of North America, North of Mexico. Gainesville, FL, University Press of Florida.)

In Massachusetts, regional MCPs and MDPH employ entomologists to sort and identify sampled mosquitoes.

AERIAL APPLICATION EFFICACY PROTOCOL FLOWCHART

I. Trap Type:

When an aerial spray intervention is necessary to reduce elevated arbovirus risk, mosquito control and public health professionals use:

- CDC light trap(s) baited with CO_2. The CO_2 will be delivered either via a calibrated metered flow of 250-500cc/min from a secured pressurized cylinder, or as a non-metered flow from sublimating dry ice (2 lbs / trap/night).

II. Trap Activation and Sample Collection

Each mosquito control and public health professional will:

- Install the CDC trap(s) at the designated location no later than one hour before astronomical sunset, or set to activate automatically at the assigned time if the location is secure.
- Set the CDC trap(s) so that the collection period is no less than one full trapping night.
- Remove CDC trap(s) the following calendar day, no earlier than 3 hours after astronomical sunrise, or set to automatically stop collecting (and retain the sample).
- Conduct one night of pre-trapping with CDC traps before the aerial spray intervention.

III. Trap Deployment

CDC traps should be:

- Suspended at a height of approximately 4 feet off the ground.
- Installed away from competing light sources and obstructions such as buildings.
- Located along the intersection of differing habitats to maximize local diversity.
- Lat/long recorded, and further identified by the name of the community, street address (if relevant) or other physical or ecological indicator.
- Used to compare treated and non-treated areas and be placed in similar habitats to the extent possible as coordinated by pre-planning efforts prior to an aerial spray intervention.
- Set a minimum of two miles inside or outside the spray zone to reduce interference from spray drift.
- Placed in proper location keeping in mind that there can be excluded or no spray areas within a spray block.

AERIAL APPLICATION EFFICACY PROTOCOL FLOWCHART (cont'd)

IV. Trap Density

Mosquito control and public health professionals:

- Will use one CDC trap, and not more than four traps to monitor each treatment and comparison block. Note: If more than one trap is located within the same area, the trap should be placed at least 300-400 feet apart to avoid trap competition.
- Deploy the CDC traps so that, to the extent possible, their samples are representative of the density of adults of target species in geographically distinct areas.
- Set at least 3 traps in the treatment area and 3 in the non-treatment area to evaluate efficacy.
- Distribute traps within the spray block to be representative of the various types of mosquito habitats that are being targeted.

V. Mosquito Identification

Mosquito control and public health professionals will:

- Identify to species all female mosquitoes from traps.
- Count all female mosquitoes including damaged individuals, and reported on standard collection forms.
- Insure that trap contents are subjected to aliquot reduction when sample size exceeds 400 mosquitoes / trap / night.
- Store, chill, and sort collections on a chill table or on ice. Note: Samples of female mosquitoes of target species should be assayed for virus as soon as possible, and other samples should be ideally deep-frozen (-20 degrees C or –4 degrees F).

VI. Age Assessment

Note: If resources along with trained professionals are available, dissection techniques to assess parity rates can be employed for the purpose of obtaining additional data on the physiological age of collected mosquitoes.

Mosquito control and public health professionals will:

- Knock down mosquitoes with CO_2, dissect, and process in as fresh a condition as possible. Ovaries should be removed into tap/saline water and placed on a microscope slide to air dry. Slides can be stored for later examination under a microscope (Detinova et al 1962).
- Freeze mosquitoes quickly and placed into tight tubes and hold in a freezer for months to be processed at a later time. *Note: This is not recommended since freezing disrupts the ovarian cells and trachea making age determination more difficult.*

CONCLUSION

For the purpose of moving toward uniformity in establishing meaningful measures to determine efficacy of interventions such as aerial adulticide applications, the best protocol will contain challenges and limitations when measuring impacts to biological organisms such as mosquitoes.

During any given aerial adulticiding application, adult mosquitoes can be resting, digesting blood meals, or seeking hosts at varied times and may escape control. As outlined, various trap types can bias toward specific mosquito behavior such as the resting box which sample *Culiseta melanura* mosquitoes that have already blood fed. Similarly, gravid traps sample or collect mosquitoes that are ready to oviposit (lay eggs).

These conditions may allow these mosquitoes to escape the impact of any single aerial adulticide application (only reducing those mosquitoes on the wing). Those mosquitoes escaping treatment will continue to be collected by sampling devices and effect meaningful comparisons. As a result, trap placement is critical to this protocols objective.

Therefore, the emphasis of this protocol aims to achieve the proper placement of the least biased sampling device such as the CDC light trap baited with CO_2 well within the spray zone at least 24 hours prior to the intervention and 24 hours after the intervention to assess impact on the target population.

Literature Cited

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Appendix 4: Aerial Application Service and Insecticide ANVIL 10+10 ULV Information Sheet

Aerial Application Service

Dynamic Aviation Group, Inc.
Post Office Box 7
1402 Airport Road
Bridgewater, VA 22812-0007

Aircraft Type: Specially Equipped Twin Engine, Turbine Powered King Air 90.
Speed of Aircraft: 150-knots/170 mph.
Altitude or height of aircraft: 300 feet AGL (Above Ground Level).
Swath Width: 750-1,000 ft.
Aircraft Capacity for Pesticide: 90 gallons per load when using Anvil 10+10 equating to covering 42,000 acres. *Note 640 acres equals 1 square mile*
Aircraft Contractor: Dynamic Aviation Group, Inc., Post Office Box 7, 1402 Airport Road, Bridgewater, VA 22812-0007, Telephone: (540) 828-6070,FAX: (540) 828-4031. E-Mail: info@dynamicaviation.com
Aircraft Contract minimum acreage range: 3,000 to 24,999 acres.
Aircraft Contract maximum acreage range: 25,000 to 500,000 acres and greater.
Application Window: The "optimum" spray window depends upon the target species of mosquito, and the hours during which that species is most active. A "typical" spray window would begin approximately sunset and conclude after midnight.
Aircraft Flight Path: Flying at 170 MPH and assuming a 1,000-foot swath width, the King Air 90 is able to cover 343 acres per minute. *Note 640 acres equals 1 square mile. It would take approximately 2 minutes to treat a 1 square mile area*
Distinct Application System: Rotary or flat fan nozzles set up to provide optimized spray pattern for adult mosquito control.
Aircraft Noise: The twin turbine King Air is exceptionally quiet, and will likely be overhead and gone before most people hear it coming.
Aircraft Spray Visibility: The actual spray that comes out of the nozzles often is visible during daylight/dusk hours. However, if spraying takes place at night, it is unlikely that the spray would be visible.
Aircraft Operational Efficiency: The fewer blocks or zones that need to be excluded as "no spray" the more operational efficiency can be expected.
For More Information: Website: http://www.dynamicaviation.com/index.html

Insecticide Contractor

Clarke Mosquito Control Products, Inc.
P.O. Box 72197
159 N. Garden Avenue
Roselle, Il 60172

Pesticide of Choice: ANVIL 10 + 10 ULV
EPA Registration #: 1021-1688-8329
Active Ingredient: sumithrin 10.00% and Piperonyl Butoxide 10.00%
Note: This product is a synthetic pyrethroid in the Anvil formulation that replicates the mosquito fighting properties of pyrethrum, an extract of the chrysanthemum flower. Sumithrin is synergized with piperonyl butoxide (PBO) providing a fast knockdown of adult mosquitoes.
Signal Word: Caution
EPA Classification: Non-restricted or General Use
Target: Adult Mosquitoes
Use: Outdoor Residential and Recreational areas, woodlands, swamps, marshes, overgrown areas, and golf courses
Manufacturer: Clarke Mosquito Control Products, Inc., 159 N. Garden Avenue, Roselle, Illinois 60172, Phone: (800) 323-5727, Fax: (800) 832-9344, Email: Larryrerickson@clarkemosquito.com
Max Rate of Application: 0.62 fluid ounces per acre
Dosage Rate: 0.0036 pounds of active ingredient per acre
Equipment: Ultra Low Volume (ULV) technology
Droplet Sizes: Volume Median Diameter produced is less than 60 microns and that 90% of the spray are contained in droplets smaller than 100 microns
Period droplets are airborne: Depending on environmental conditions, treatment block size, spray droplets should move through the target area 30-60 minutes after application is completed.
Optimum Ground Application Wind Speed: No greater than 10 MPH
Optimum Application Temperature Range: 65 degrees or greater but range of temperatures between 65 and 57 are acceptable.
For more information: Website: http://www.clarkemosquito.com/

Appendix 5: Water Quality Sampling for Mosquito Control Aerial Chemical Application

TO: Gary Gonyea, BRP/WW

CC: Dave Terry, Director DWP, BRP
Robert Nuzzo, BRP

THROUGH: Carol Rowan West, Director, ORS
FROM: Michael Hutcheson and Diane Manganaro, ORS
DATE: March 7, 2006
SUBJECT: Water Quality Sampling for Mosquito Control Aerial Chemical Application

Signed original on file in ORS

This memo is in response to your e-mail dated Tuesday, February 28, 2006 to Michael Hutcheson, in which you requested the opinion of the Office of Research and Standards (ORS) regarding if and how environmental monitoring recommendations would change if malathion were to be used for aerial spraying of mosquitoes instead of sumithrin to control the spread of Eastern Equine Encephalitis (EEE) virus or West Nile Virus (WNV). The monitoring plan that was developed in conjunction with proposed spraying of sumithrin, entitled "Water Supply Monitoring Plan to Assess Potential Impact of Mosquito Control Spraying During Any Public Health Emergency To Drinking Water", provides a protocol for sampling drinking water reservoirs and finished waters in order to evaluate potential public health effects as well as benthos and water chemistry in order to evaluate potential ecological effects. We reviewed this plan in light of the information we have on Malathion to determine whether it could be adapted to spraying with Malathion. Our recommendations regarding the extent of monitoring to be conducted to address human health and ecological concerns are presented below.

Recommendations:

1. Based on the discussions provided below, an evaluation of potential drinking water impacts indicates that neither sumithrin nor Malathion applied aerially would likely pose a threat to public health via ingestion of drinking water. An extensive water-monitoring program, such as detailed in the Monitoring Plan under the Design Protocol, may not be needed. However, confirmatory sampling of representative water supply areas and finished waters would nevertheless be a worthwhile endeavor for both informational purposes and to provide reassurance to the public that aerial spraying of either pesticide did not pose a threat to public health via contamination of drinking water. The Drinking Water Program is in the best position to determine the scale of such a sampling program with regard to how many and which water supplies should be sampled. We also note that the sampling intensity presently described is not needed. As a cost-cutting measure, sampling could be reduced from the three sampling points described in the protocol to two, including the intake water prior to treatment and the finished water. Sampling of untreated surface water seems unnecessary in this case since the intake water closer to the treatment/distribution facility is being sampled concurrently. Finished water need only be analyzed if the intake samples test positive for the insecticide. Samples need only be collected twice, once shortly after spray operations take place and approximately twenty-four hours later.

2. Based on the discussions below pertaining to potential ecological effects, an evaluation of potential effects on aquatic biota cannot be ruled out for either pesticide. It is our opinion that sampling of surface waters and biota as outlined in the monitoring plan for pesticides/benthos of August 2005 should be conducted in conjunction with aerial application of either pesticide. The monitoring plan specifies that pre-and post-spray water sample sets should be coordinated with the water supply sampling activities; however, it is unclear as to the timing of this sampling relative to other water and benthos sampling. We question the necessity of post-application water sampling for sumithrin to accompany post-spray benthos sampling one week after application. Predicted maximum sumithrin concentrations from aerial application are so low (near the method detection limit of 0.1□g/L) and the degradation so relatively rapid (half -life on order of a couple of days) that coupled with dilution over one week, there would seem to be no chance of detecting any residual sumithrin that far after application. Similar arguments would apply to Malathion, which has a similar half-life and higher predicted initial maximum surface water concentrations. Rather, we suggest that surface water be sampled shortly after spray operations takes place (i.e., 1-3 hours), as it is during this time that pesticide concentrations at the water surface would be at their highest and have the most potential to impact aquatic life. It is our opinion that the monitoring protocol discussed above that was originally developed in conjunction with a sumithrin application can be adapted for a Malathion application.

3. Given that aerial dispersion of pesticides is of particular concern to aquatic organisms; it is recommended that, if possible, measures be taken to minimize exposure of these organisms during pesticide application. For example, fish typically feed at the surface of the water during the early mornings and evenings. When they are not feeding, there is a lower probability that they will be at the surface of the water, thus a lower probability that they will be exposed to pesticide that has been deposited to the surface of the water, which would be at a higher, undiluted concentration. We therefore recommend that the pesticide application be made in the nighttime hours, utilizing night-vision technology if necessary. A night application would also reduce potential dermal and inhalation exposures to humans, as there would be a lower probability that people would be outside during this time.

4. The proposed spraying protocol calls for an 800-foot buffer from surface water bodies. Although some drift within the 800-foot margin will likely occur, this setback is designed to minimize the amount of pesticide that will reach surface waters. One presumed rationale for employing this approach is to minimize possible effects on surface waters used for drinking water purposes. However, if direct aerial applications of these pesticides were to occur, we predict that water concentrations of the chemicals would be so far below drinking water guideline values that setbacks would not be needed. Mosquitoes tend to preferentially breed near sources of water. The margins of surface water bodies would be among these preferred breeding locations. By using a large setback distance from all surface water bodies, the area-wide application is essentially being riddled with large “holes” around surface waters, which may contain potential EEE virus-carrying mosquito populations. A smaller or zero setback distance would permit more comprehensive vector eradication with the tradeoff of a more certain risk to aquatic organisms, especially those in more shallow waters. Other measures could be taken to reduce exposures such as the one discussed in item #3 above. We recognize that making a decision on the most appropriate setback to use has its

tradeoffs and is ultimately a management decision where improved mosquito control for public health protection must be balanced against public perception issues associated with direct application of these insecticides near surface waters used as drinking water sources.

Discussion:

The above recommendations are made based on our evaluation of available information that we have compiled to date on sumithrin and malathion relative to potential impacts to public health via drinking water and to aquatic organisms. This information is summarized below.

1. Potential for Sumithrin Application to Impact Human Health via Drinking Water

An evaluation of potential human health risks posed by sumithrin exposure through drinking water surface water sources sprayed during pesticide application was presented in Hutcheson (2005). The memo concluded that any human exposure via drinking water to sumithrin aerially deposited to surface water during spraying would not pose a public health threat since concentrations would be well below any concentrations of toxicological and public health concern. This conclusion assumes that aerial spraying takes place in accordance with specified operational plans and that application rates do not exceed the application rate for the product provided to us for our evaluation.

> **Carcinogenicity** - Since the Hutcheson (2005) memo was written, the U.S. Environmental Protection Agency (EPA) Cancer Assessment Review Committee has designated resmethrin (another pyrethroid insecticide, having a similar mechanism of action as sumithrin) "likely to be carcinogenic to humans". There has been some suggestive evidence of an increased incidence of liver tumors in rodents as well as a potential for sumithrin to increase expression of a gene involved in the proliferation of mammary tissue leading to the development of breast cancer (Cox et al., 1987 as cited in WHO, 2002; SCDHS, 2005; Kasat et al., 2002 as cited in SCDHS, 2005; Cox, 2003). The EPA has not yet evaluated sumithrin for carcinogenicity and any information is still speculative. However, even if we assumed that sumithrin is also likely to be carcinogenic to humans, our calculations indicate that predicted concentrations of sumithrin in the field are not expected to exceed the recommended benchmark RfDs and drinking water levels determined for this chemical. The Department's policy with regard to developing a drinking water guideline for a possible carcinogen for which there is no quantitative potency information, is to apply an uncertainty factor of 10 to the drinking water guideline, thereby numerically reducing the value by 10. Given that ORS' evaluation indicated that drinking water guidance for sumithrin is several orders of magnitude greater than predicted field concentrations, an additional factor of 10 will not change the conclusion reached above that a public health or ecological threat would not be expected from an application of sumithrin at maximum application rates.

2. Potential for Malathion Application to Impact Human Health via Drinking Water

– Massachusetts conducted an aerial application of Malathion in the late summer of 1990. In conjunction with this application, ORS conducted an evaluation of potential human health and ecological risks posed as a result of exposure to Malathion. As presented in two memos (Hutcheson, 1990a; Hutcheson, 1990b), ORS concluded that

drinking water should not be adversely affected by spraying conducted under the assumed spraying conditions. The evaluation concluded that after direct spraying (if that inadvertently were to have occurred) field concentrations of Malathion in surface waters should have been an order of magnitude lower than the drinking water guideline for Malathion. In practice, measured field concentrations of Malathion immediately after spraying using a 300-foot buffer in most lakes sampled agreed closely with predicted concentrations.

Assuming that spraying methodology and insecticide application rate of malathion are the same as those assumed for the 1990 application, potential future applications of malathion are also not expected to pose a public health threat from exposure to malathion in drinking water.

3. Potential for Sumithrin Application to Impact Non-Target Organisms – ORS has not conducted a formal evaluation of the potential for an aerial application of sumithrin to impact biota in the area of application. However, as indicated in Hutcheson and Manganaro (2005), our review of sumithrin has indicated that it has high non-target toxicity potential to aquatic life, particularly fish. The sumithrin product, Anvil 10+10, has a label warning against use directly on water or near surface water. In addition, sumithrin formulated products are typically mixed with the synergist piperonyl butoxide (PBO), which enhances toxicity by inhibiting metabolism of the insecticide. Thus, the potential for ecological effects resulting from an aerial sumithrin application cannot be ruled out should drift occur.

4. Potential for Malathion Application to Impact Non-target Organisms – An evaluation for potential ecological effects was also conducted for the 1990 Malathion application. This application conservatively assumed that Malathion would be deposited directly over a body of water. The evaluation concluded that, based on the estimated concentrations of malathion in surface water, toxicity to invertebrates (aquatic insects and crustaceans) would be likely under this scenario. In addition, while the evaluation found that most fish should not be affected by the surface water concentrations of Malathion that would result from an aerial application; there are several species that would likely be affected. In general, those species that inhabit shallow waters or that remain near the water's surface would most likely be exposed to the highest concentrations of Malathion and would thus be most adversely affected. In practice, there were a number of fish kills that occurred along flight paths shortly after Malathion application.

Again, assuming that spraying methodology and the insecticide application rate of malathion are the same as those used for the 1990 application, it can be concluded that the potential for ecological effects resulting from an aerial malathion application cannot be ruled out should drift occur.

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Appendix 6: Honeybee Monitoring Protocol for Aerial Mosquito Adulticide Application

Introduction

Honey bees and other insect pollinators generally forage when temperatures are above 55-60 degrees (F) Fahrenheit during daylight hours. Honey bees, bumble bees, and solitary bees do not forage at night or during very cool weather. Insecticides applied during the day at optimal temperatures inadvertently to melliferous (honey bearing) bloom will cause severe pollinator losses. Treatments made during the night and very early morning in the proximity of desirable flowering nectar and pollen sources are the safest for pollinators.

Mosquito Adulticide Applications and Honeybees

Mosquito adulticiding can progress from sunset to sunrise with little honey bee mortality because of honey bee flight inactivity and the short half-life of sumithrin. Nonetheless, the Department of Agricultural Resources (DAR) will carry out the following protocol as a part of any SRMCB supervised aerial mosquito adulticide operation.

Protocol to Monitor Honeybees

In the event aerial adulticiding is necessary, MDAR will monitor selected honeybee hives in proximity of proposed application areas to evaluate hive health prior to Anvil 10+10 ULV application for potential impacts on domestic bees. Approximately 10-15 hives will be inspected inside the spray area, and 10-15 will be inspected outside the spray area as a control group. Hives registered with MDAR will be chosen at random. Contacts with the appropriate and area specific beekeeper associations (e.g. Bristol and Plymouth County Beekeepers Associations) will be made.

Pre-Spray Inspections

Pre-spray inspections will be made as close to the spray event as possible, although if time does not permit, MDAR may rely on data from inspections made earlier in the season.

Post-Spray Inspections

Post-spray inspections will occur at two time periods to evaluate acute and delayed impacts on colonies. Post spray evaluations will occur at the following intervals:
Days 1-3 Post-Spray
Day's 7-10 post

Reporting of Results

MDAR will issue a report between 21 and 30 days after the spray operation ceases. The report will be posted on the MDAR website (http://www.mass.gov/agr/).

Appendix 7: Biomonitoring Plan: Pesticide-Related Impacts to Macroinvertebrates (Benthos) Following Aerial Application Macroinvertebrate sampling Discontinued and replaced by the following Memorandum

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MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs
Department of Environmental Protection
Central Regional Office • 627 Main Street, Worcester MA 01608 • 508-792-7650

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

RICHARD K. SULLIVAN JR.
Secretary

KENNETH L. KIMMELL
Commissioner

Memorandum

Subject: Biomonitoring of Anvil 10+10 Aerial Spray Impacts

MassDEP proposes dropping the biological monitoring in aquatic habitats related to aerial spray operations targeting EEEv vectors (mosquitoes). MassDEP/DWM staff were involved in collecting aquatic macroinvertebrate (benthos) samples in an effort to detect impacts from three separate aerial spray operations. The first was in 1990, when malathion was used; the two most recent events were in 2006 and 2010 involving the insecticide Anvil 10+10 (sumithrin + piperonyl butoxide). In each instance macroinvertebrates were collected from aquatic habitats at sites both inside and outside (reference sites) the spray zones, before and after aerial applications (for details see Nuzzo 1990, Nuzzo 2006, and Nuzzo 2010).

Acute impacts to the aquatic macroinvertebrate communities were not detected in conjunction with any of these three aerial spray operations. It is worth noting that in 1990 and 2006 all the sampling locations (Table 1 and Table 2) were moderate gradient streams except the Winnetuxet River (Table 2), which was a low gradient river with a bordering wetland. In 2010 sampling targeted lentic habitats (Table 3), including the station on the Nemasket River.

From meetings recapping the “mosquito season” for 2006 and 2010, it appeared more concerns were raised over impacts to non-target aerial and terrestrial invertebrates than with impacts to the aquatic invertebrates. While MassDEP/DWM staff made casual observations of the presence of spiders and winged insects during their post-spray aquatic sample collections, questions about the spray impacts on these populations were raised. It does seem there is more value at this juncture in surveying populations of aerial/terrestrial invertebrates to address questions that were raised about their vulnerability than in continuing biomonitoring in aquatic habitats.

Cited Reports

Nuzzo, R.M. 1990. Technical Memorandum #90-12: Assessment of instream impacts from aerial spraying of malathion. DEP, Technical Services Branch. Westborough, MA. 7 pp.

Nuzzo, R.M. 2006. Technical Memorandum TM-S-20: Biomonitoring results from streams in Southeastern Massachusetts within zone of aerial application of Sumithrin and Piperonyl Butoxide. MassDEP/Div. of Watershed Management. CN 267.0. 11 pp.

Nuzzo, R.M. 2010. Technical Memorandum: Biomonitoring Report on the 2010 Aerial Insecticide Spraying Over Southeastern Massachusetts. MassDEP/Div. of Watershed Management. CN 308.0. 15 pp.

Table 1. Sampling locations and dates (Nuzzo 1990).

Waterbody	Location Description	Pre-spray sample date	Post-spray sample date
Assonet River	Forge St., Freetown	23 August 1990	6 September 1990
Threemile River	Harvey St., Taunton	23 August 1990	6 September 1990
Ten Mile River	Cedar St., North Attleborough	23 August 1990	6 September 1990

Table 2. Sampling locations and dates (Nuzzo 2006).

Waterbody	Location Description	Aerial Spraying Date	Sampling Dates
Canoe River	downstream from Willow St. Foxborough	Pre-spray No spray, reference No spray, reference	1 August 2006 22 August 2006 7 Sept. 2006
Satucket River	downstream from Bridge St. East Bridgewater	Pre-spray No spray, reference 23 August 2006	2 August 2006 22 August 2006 7 Sept. 2006
Jones River	downstream from Elm St. Kingston	Pre-spray 8 August 2006 23 August 2006	27 July 2006 22 August 2006 7 Sept. 2006 27 Sept. 2006
Nemasket River	@ Oliver Mill Park Middleborough	Pre-spray 8 August 2006 23 August 2006	4 August 2006 22 August 2006 7 Sept. 2006
Winnetuxet River	downstream from Route 105 Halifax	Pre-spray 8 August 2006 23 August 2006	4 August 2006 22 August 2006 7 Sept. 2006

Table 3. Sampling location descriptions and sampling dates (Nuzzo 2010).

Waterbody	**Location Designator and Description**	**Pre-spray sample date**	**Post-spray sample date**
Nemasket River	"S1": downstream from Nemasket Street and upstream from Oliver Mill, Middleborough, MA	2 Aug. 2010	12 Aug. 2010
Snipatuit Pond	"S2": littoral zone adjacent to boat launch, Neck Rd., Rochester, MA	3 Aug. 2010	11 Aug. 2010
Skeeter Mill Pond	"S3": littoral zone along northern edge; access from Water St., Bridgewater, MA	3 Aug. 2010	12 Aug. 2010
Elm St. Impoundment (Jones River)	"S4": littoral zone along southern edge; access from park at Elm St., Kingston, MA	4 Aug. 2010	11 Aug. 2010
Park Pond	"R1": littoral zone along northern edge, east of inlet; Choate Park, Medway, MA	2 Aug. 2010	16 Aug. 2010

Appendix 8: Water Supply Monitoring Plan to Assess Potential Impact of Mosquito Control Spraying During Any Public Health Emergency to Drinking Water

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INTRODUCTION

In the event that the Department of Public Health (MDPH) issues a "Certification that Pesticide Application is Necessary to Protect Public Health", the area(s) identified by MDPH for coordinated mosquito control efforts under the direction of the State Reclamation and Mosquito Control Board will be sampled to assess potential impact. The following protocol will be utilized to insure successful operational outcomes and avoidance of environmental impacts.

Coordination Of Surface Water Supply Monitoring Will Involve The Following Programs And Staff:

AGENCIES:

Department of Environmental Protection (DEP)
Bureau of Resource Protection (BRP)
Office of Research & Standards (ORS)
Drinking Water Program (DWP)
Division of Watershed Management (DWM)
Northeast Regional Office (NERO)
Southeast Regional Office (SERO)
Central Regional Office (CERO)
Western Regional Office (WERO)
Massachusetts Department of Agricultural Resources (MDAR)
State Reclamation and Mosquito Control Board (SRMCB)
Massachusetts Pesticide Analytical Laboratory (MPAL)
Division of Fisheries and Wildlife (DFW)

STAFF:

Gary Gonyea, BRP, SRMCB Member	617-556-1152
Marielle Stone, Acting Program Director, DWP, Boston	617-292-5529
Jonathan Hobil, DEP, SERO	508-946-2870
Michael Hutcheson, DEP, ORS	617-292-5998
Mike Quink, DWP SERO	508-946.2766
Richard Rondeau, DWP SERO	508-946-2816
Jim Dillon, DWP NERO	(978) 694-3231
Andrea Lemerise, DWP CERO	508-767-2723
Deirdre Cabral, DWP WERO	413-755-2148
Dennis Dunn, DWM CERO	508-767-2874
Taryn LaScola, MDAR,	617-828-3793
Mike McClean, MDAR,	617-828-3792
Mark Buffone, SRMCB, MDAR	617-626-1777
Jeffery Doherty, MPAL Lab Manager and Chief Chemist	413-545-4369

DESIGN PROTOCOL FOR COLLECTION, STORAGE, AND TRANSPORT OF SURFACE WATER SUPPLY SAMPLES:

Post aerial spray surface water supply samples will be collected as described in the following paragraphs from:

1) the raw water sample at the tap of the intake of the surface water supply (prior to treatment) to the treatment/ distribution facility; and
2) the finished water sample following all treatment/filtration steps and prior to the first consumer intake.

All Public Water Systems with Surface Water Supply sources in areas that might be sprayed will each collect two 1-liter water samples:

1) From both the raw and finished water taps the morning before the possible spray operations in those areas and bring these samples to SERO;
2) From both the raw and finished water taps by 8:00 AM the morning after the spray operation in that region. By 8:30 AM DEP SERO will be notified of the preceding evening's exact spray area and will call **only** those Water Suppliers whose area was sprayed the evening before by 9:00 AM to request that they bring their samples to DEP SERO. Water suppliers not contacted by 9:00 AM can discard their "post-spray" samples.

Only those Public Water Systems which have been notified that their area was sprayed and who sampled at 8 am the first morning after spraying will:

sample from both the raw and finished water taps by 8:00 AM on the day after the first set of post-spray samples were taken.

All samples should be brought to Lakeville by 11 AM and packaged for trip to PAL in Amherst.

Comment: Both raw, untreated surface water and finished treated water samples will be collected and analyzed to assess the success of the water treatment facilities to remove residues.

Non Public Water Supply Surface Waters In addition to the Public Water Supply sampling, **a water quality grab sample will be collected by DEP Regional or MDAR staff by 8:00 AM the morning after an aerial spray event from up to six stations on non-Public Water Supply surface water bodies within the spray zone.** These surface water samples will be collected in acid-washed, 1L brown, Teflon capped, wide-mouth glass bottles, kept on ice and transported to DEP Regional office for shipment to UMASS PAL. The surface water samples will be analyzed for both pesticides and PBO by UMASS PAL.

DEP staff will:

1) Ensure acid-washed sample collection bottles (1L brown, Teflon capped *wide-mouth* glass bottles) are available in timely fashion to DWP Regional Office staff (via DEP courier delivery) for pickup/and or delivery to water systems, and for collection of surface water samples at benthos monitoring sites;

2) Contact water systems, coordinate distribution of sample collection bottles, and coordinate collection of water samples;
3) Identify and Collect water quality samples from up to 6 non-PWS surface waterbodies within the spray zone and deliver to DEP Regional Office;

4) Ensure that ice chest(s) and ice/cold packs are available for use by each DEP Regional Office for transportation and storage of water samples;

5) Identify available staff from either the Pesticide Bureau (Boston Office) or DEP offices that will be responsible for water sample pickups from the DEP Regional Offices and delivering them to the Massachusetts Pesticide Analysis Laboratory (MPAL) at the University of Massachusetts (UMASS) Amherst, for analysis;

6) Will pickup ice chests at 11 A.M. for transport to UMASS each morning, if more than one day of spraying is planned. MDAR staff may substitute;

Laboratory analyses of water samples will be conducted by UMASS MPAL using standard QA/QC procedures with analytical costs assessed to MassDEP. ***An Intergovernmental Service Agreement (ISA) was established between MassDEP and the UMASS PAL to cover the costs of the water quality analysis. This ISA is effective for three years and will need to be renewed in 2013.***

1) Samples will be analyzed using gas chromatography (GC) at a limit of detection of 0.1 ug/L (micrograms/liter) (parts per billion). The detection of the chemical with GC will be reconfirmed using GC/mass spectroscopy (GC/Mass Spec). If pyrethroid pesticide is used the samples will also be analyzed for PBO (Piperonyl butoxide) at a limit of detection of 0.1 ug/L (micrograms/liter) (parts per billion)

HEIRARCHY OF DECISION MAKING FOR SAMPLING, COLLECTION, STORAGE, AND TRANSPORTATION

1. Gary Gonyea (SRMCB; DEP Boston) contacts ***BRP Division Director*** and then Gary Gonyea calls:

A. DEP Regional Offices and the DEP/DWM with information on what will be sprayed, along with the how, when and where. Gary Gonyea will also call Richard Hartley, DFW (508) 389-6330, Steve Hurley, DFW (508) 759-3406, and Paul Caruso, DWM (508) 990-2860 x107 to alert fisheries biologists.

B. Pesticide Enforcement personnel (DAR) prior to spraying to make sure both agencies have an adequate supply of sample bottles on hand or in case bottles need to be ordered; to have sample bottles shipped to SERO and/or NERO via DEP courier at the appropriate time.

C. Pesticide Enforcement personnel (DAR) to work and coordinate with the DEP Regions for the collection and transport of sample bottles between the DEP Regions and the UMASS-Amherst Pesticide Analytical Laboratory.

2. ***Richard Rondeau & Michael Quink*** (DWP/SERO), James Dillon (DWP/NERO), Andrea Lemerise (DWP/CERO), and Deirdre Cabral (DWP/WERO):

   A. Establishes standardized sample identification for samples collected from the program (use DEP/DWP source IDs and, if available, established sample location IDs);

   B. Coordinates and educates water systems on the sampling, labeling and transportation procedures;

   C. Contacts all surface water systems at least a week prior to any spraying to have them pick up the bottles and to prepare them for collecting water samples.

   D. Informs water systems within two days of spraying to be ready to collect (1) two POST SPRAY samples by 8:00 AM the morning after and by 8:00 AM 24 hours later. Pass along sample number scheme to DAR.

   E. Checks DAR web site to confirm area sprayed http://www.mass.gov/agr/spray-map/ and contacts water systems within spray zone to bring samples to Lakeville.

   F. Coordinates collection of up to six samples from non-PWS waterbodies within the spray zone by 8:00AM the morning after an aerial spray event and transport samples to Lakeville.

   G. Contacts the MDAR Division of Crop and Pest Services person or DEP staff responsible to make sure that PWS and non-PWS water samples are picked up each morning at 11 A.M. for transport to the Pesticide Lab at UMASS Amherst.

   H. Informs water systems on the standard way of filling out the chain of custody and bottle labels (Date/Time of Collection/location of sample/Name of Surface Water Source Water; PWS ID number).

   I. Identifies a central location for the ice chest and provides ice for storing sample bottles after they have been delivered to DEP.

   J. Contact MDAR, and the water systems about any matters related to the sample-bottle pickup and delivery logistics during pre and post spraying activities;

3. Mark Buffone (MDAR/SRMCB) and Gary Gonyea (DEP/BRP) will:

   A. Make the necessary arrangements with the UMASS Pesticide Laboratory (MPAL) to provide the analytical testing with costs borne by participating agencies or paid from emergency funding.

   B. Provide the chain of custody paperwork for shipping all water samples;

   C. Ensure that MPAL performs the appropriate QA/QCs on the analytical results, including recovery results on spiked samples.

D. Report the results of water analyses to SRMCB and DEP/ORS within 1 Business Day of reports received by DAR/DEP. **Note: Anticipated turnaround time for test results is three days.**

Sample Collection, Preservation, and Handling

Grab Sample Bottle: One liter or 1 quart wide mouth, amber glass, fitted with a screw cap lined with Teflon. The bottle and cap liner must be acid-washed, rinsed with acetone or methylene chloride, and dried before use to minimize contamination. Grab samples must be collected in glass containers, labeled, and kept on ice for transport to DEP Regional Office and MPAL.

Appendix 9: Monitoring the effects of aerial applications of adulticide insecticides on state listed invertebrates

Goal

To determine whether aerial applications of adulticide insecticides for controlling arbovirus vector mosquitoes result in the take of state listed invertebrates.

Step 1. MDAR via the State Reclamation and Mosquito Control Board and MDPH based on the results of arbovirus surveillance protocols determine whether aerial adulticide applications are necessary and where applications need to be conducted.

Step 2. NHESP selects areas to be excluded from aerial adulticide applications based on high concentrations of vulnerable state listed species.

Methods

Direct measurement of state listed populations is not feasible due to the low numbers of individuals comprising these populations. Common invertebrates, especially Lepidoptera having a body size similar to the body sizes of state listed species, are used to determine effects of aerial applications of insecticides on protected species.

Step 3. NHESP determines whether state protected species are at risk. If a species flight time coincides with the application period within priority habitat the species may be at risk. If a species is pupating or otherwise rendered unlikely to be at risk during the application period or if no vulnerable invertebrate priority habitats are scheduled for aerial applications no monitoring is necessary.

Step 4. NHESP determines that monitoring is required. NHESP contracts with pre-qualified vendor selected from Master Service Agreement #___. Contractor(s) in consultation with NHESP select comparable sites and treatment sites for sampling nocturnal insects with ultraviolet light traps. Traps are to be deployed at least 2 nights (preferably 3) immediately prior and 2 nights (preferably 3) immediately post application or as soon as weather conditions allow. Contractor sorts, identifies and stores Lepidoptera of appropriate sizes to species level.

Step 5. Contractor prepares report according to an agreed upon timeline. The report presents findings on the ratio of species recovered in traps prior to applications to those recovered after the applications are completed.

Appendix 10: Certified Organic Farms List

Farm Name	Town
Allen Farms	Westport
Apex Orchards	Shelburne
Appleview Farm	Marlboro
Area 51	Dracut
Astarte Farm	Hadley
Atlas Farm	Deerfield
Bagdon Brothers Farm	Sunderland
Bartlett Ocean View Farm LLC	Nantucket
Bay End Farm	Borne
Berkshire Bounty Farm	Southfield
Billingsgate Farm	Bryantville
Bird of the Hand Farm	Sterling
Blue Heron Farm	Charlemont
Blue Heron Organic Farm	Lincoln
Box Hill Farm	Boston
Butter Brook Farm	Acton
Cape Cod Organic Farm	Barnstable
Cape Farm Supply and Cranberry Co.	Harwich
Chamutka Farm	Whately
Chang Farm	Whately
Chase Hill Farm	Warwick
Chase Meadow Farm	Weston
Choke Cherry Farm	Duxbury
Colchester/Maribett Farm	Plympton
Collins Bog	Waquoit
Colrain Dairy Farm	Colrain
Conant Brook Farm	North Kingstown
Couch Brook Farm	Bernardston
Cranberry Acres - Vineyard Open Land Foundation	Tisbury
Cranberry Hill	Plymouth
Delta Organic Farm	Amherst
DeNike Bog	Plymouth
Elmdale Organic Farm	Franklin
Enterprise Farm	Concord
Eva's Garden	Dartmouth
Farm School Apprentice Program at Maggie's Farm	Orange
Fresh Meadows	Carver
Full Bloom Market Garden LLC	Whately

Golden Rule Farm	Middleboro
Goldthread Herb Farmacy	Conway
Goshen Hill Garlic Farm	Dracut
Great Marsh Organics	Newbury
Great Oak Farm	Berlin
Green Meadow Farm	Topsfield
Grey Barn Farm Enterprises LLC	Chilmark
Heaven's Harvest Farm	New Braintree
Heirloom Harvest CSA	Westborough
Holly Hill Farm	Cohasset
Holmes Farm	Manomet
Hopestill Farm	Sherborn
Hutchins Farm	Concord
Jim Bunker's Tree Farm	West Wareham
Juggler Meadow Farm	Amherst
Justamere Tree Farm	Worthington
Kelly Farm	Cummaquid
Kettle Pond Farm	Berkeley
Lakeside Organic of Hadley	Hadley
Lanni Orchards Inc.	Lunenburg
Left Field Farm	Middlefield
Lifeforce Growers	Waltham
Lindentree Farm	Lincoln
Lucky Field Organics	Rochester
Magnolia Farms	Gloucester
Many Hands Organic Farm	Barre
Maple Row Farm	Conway
Matt's Organic Gardens	Dennisport
Misty Brook Farm	Hardwick
Mitchell, Pete	Wendell
Morning Sun Farm	Rehoboth
Nantucket Conservation Foundation, Inc.	Nantucket
Natick Community Organic Farm	Natick
Next Barn Over Farm	Hadley
North Plain/Blue Hill Farm	Great Barrington
Oakdale Farm	Rehoboth
Old Friends Farm	Amherst
Old Frog Pond Farm	Harvard
Old Town Organics	Newbury
Olson's Greenhouse #s 12 and 14	Raynham
Orcranics	Buzzards Bay
Out Of The Woods Farm	Hardwick

Pioneer Valley Organic Farm	Chester
Plainville Farm	Hadley
Plato's Harvest	Middleboro
Pleasant Lake Farm LLC	Harwich
Prospect Hill Farm	Plympton
Pumpkin Pond Farm	Nantucket
Red Fire Farm	Granby
River Rock Farm	Westport
Riverland Farm	Sunderland
Robinson Farm	Hardwick
Rogers, William	Middleborough
Russell's Garden Center	Wayland
Serving Ourselves Farm	Boston
Shaw Farm Dairy	Dracut
Sidehill Farm	Ashfield
Silferleaf Farm	Concord
Silverwood Organic Farm	Sherborn
Simple Gifts Farm	Amherst
Spicza, Dennis	Groton
Squanit Bog	Carver
Standish Farms	Duxbury
Stannard Farms	West Tisbury
Stone Soup LLC	Norton
Sweet Water Farm	Petersham
The Clover Path Garden	Acushnet
The HERB FARMacy	Salisbury
The Herb Hill MicroDairy	Andover
Three Rivers Farm LLC	Palmer
Tripp Farm	Westport
Umass Crop Research & Education Center	Amherst
Upinngil	Gill
Ward's Berry Farm	Sharon
Web of Life Farm	Carver
Westfield Acres Farm	Sandwich
Winter Moon Farm	Hadley
Wise Acre Farm	Sunderland
Wolfe Spring Farm	Sheffield
Wright-Locke Farm	Winchester

Appendix 11: Commercial Freshwater Fish Farm List

Fish Farm	Town
Akins, Alice B	
Alden Research Laboratory	Holden
Australis Aquaculture, Llc	Montague
Berkshire Hatchery Foundation	Monterey
Bitzer Hatchery	Monatgue
Blue Stream Hatchery, Inc.	West Barnstable
Bottomley, Fred	North Attleboro
Brewster Hatchery	Plymouth
Clancy, John	Norfolk
Clear Water Bait Farm	Granby
Double M Cranberry	Rochester
E & T Farms, Inc.	West Barnstable
Four Stars Farm	Northfield
Generazio, Ben	Medway
Gilbert Trout Hatchery	Plymouth
Great Brook Trout Farm	Bolton
Hanson Farm, Inc.	Bridgewater
Heron Haven Trout Farm	Granville
Jarvenpaa, Steven	Westminster
Lahti Tree Farm	Lunenburg
Lake George Sportsman'S Club	Southwick
Lamoureux Greenhouses	Brookfield
Laprade, Robert	Spencer
Lookout Farm	Natick
Mcgrath, Robert	Carver
Mclaughlin Fish Hatchery	Belchertown
Michael'S Wholesale Bait	West Springfield
Mohawk Trout Hatchery	Sunderland
No Attleboro National Fish Hatchery	North Attleboro
Nook Farm Fisheries	Plymouth
Orsillo, Thomas	Gloucester
Outdoor Sports Expo Group	Granby
Re-Vision House	Dorchester
Richard Cronin National Salmon Station	Sunderland

Appendix 11: Commercial Freshwater Fish Farm List (cont'd)	
Fish Farm	**Town**
Robbins Trout Farm	Wareham
Roger Reed State Salmon Hatchery	Palmer
Salem State College	Salem
S.O. Conte Anadromous Fish Lab	Turners Falls
Sandwich Hatchery	Sandwich
Smithers Viscient	Wareham
Stone Hill Trout Farm	New Salem
Sunderland Hatchery	Sunderland
The Veggie Basket	Russell
Thistle Hollow Farm	Berkley
Uhlman, Peter	Bridgewater
Uncle Of Watie Akins	Wareham
Wiinakainen, Benjamin	Gardner
Zecco, Patrick	Northborough

Appendix 12: Bee Keeper Association Notification Tree Contact List

County Association	President	Secretary
Barnstable	Marte Ayers	Claire Desilets
Bristol	Greg Boyd	Bill Russell
Essex	Pete Delaney	Candace Levy
Franklin	Dan Conlon	
Hampden	Jim Stefanik	Pam Rys
Hampshire	No President	Dan Conlon
Middlesex	Rick Reault	
Norfolk	Tony Lulek	
Berkshire	Tom Stefanik	
Plymouth	Chuck Marchewka	
Worcester	Bob DeBoer	
Massachusetts Beekeeper Association	Dan Conlon	Paul Desilets

Appendix 13: Contacts for Conducting Control of Adult Mosquitoes (Vector Species)

Contact For Aerial Applicator Service *(Dynamic Aviation Group, Inc.)*

The decision to conduct an aerial spraying operation will trigger the immediate contacting of the aerial applicator service, Dynamic Aviation Group, Inc. to implement emergency and/or area-wide vector control services for the purpose of preventing significant human risk or expansion of disease to other areas. The decision will be based upon thresholds or risk factors outlined in the 2012 State Surveillance and Response Plan and advice of the Mosquito Advisory Group (MAG).

Dynamic Aviation has the capacity to meet the needs of any aerial intervention recommended whether it is smaller targeted acreage at a minimum of 3,000 acres or larger wide-area aerial adulticide treatments upwards to and greater than 500,000 acres. The SRMCB has renewed the approved state contract with Dynamic Aviation with options to renew this contract through June 30, 2014.

Dynamic Aviation will employ twin-engine turbine aircraft - King Air-65-A90 - that typically fly at an altitude of 300 feet at a speed of 170 mph carrying 90 gallons of the approved product of choice, Anvil 10+10 (sumithrin) delivering a swath width of 750 – 1,000 feet. These aircraft are configured for nighttime operation, and applications will take place in the late evening – early nighttime hours when most mosquito species are active and treatment efficacy will be enhanced (see Appendix 4).

Contact by SRMCB will begin deployment and mobilization of aircraft including determining how many aircraft would be required, when the aircraft will arrive, and when operations will commence and be completed. Aerial adulticiding may take one or more evenings depending on weather conditions, the number of acres needing treatment, the number of aircraft, and an approved multi-hour spray window (i.e. approximately sunset through shortly after sunrise) to treat large spray blocks. If weather is not acceptable or deteriorates after the spraying has begun or should the blocks be small or scattered due to exclusions, or if a 6-hour spray window (minimum) is not available, applications will take more than one evening to complete the operation.

Contact For Insecticide Contractor *(Clarke Mosquito Control Products, Inc.)*
The decision to conduct an aerial spraying operation also will trigger the immediate SRMCB contacting of the company approved on the current state contract for mosquito control insecticide, renewed recently to insure the delivery of insecticides for emergency wide-area adulticide operations. The product of choice for any operational response will be Anvil 10+10 distributed by Clarke Mosquito Control Products, Inc.

Identification and Pre-designation of Base of Operations for Various Locations

Base of Operations have been established for the purposes of this plan with the following airports for aerial adulticide application treatments. These bases of operation are located in Essex, Norfolk, and Plymouth counties where EEEv infection has historically occurred.

If aerial adulticiding operations are necessary in Essex County, the SRMCB through its regional mosquito control district (Northeast Mosquito Management and Wetlands District) has pre-designated the *Lawrence Airport* and *Beverly Airport* as a base of operation. A Memorandum of Understanding has been developed for both these airports addressing the specific needs and requirements of the Northeast Mosquito Control District and the Airport. The SRMCB would contact both the Director of the Northeast Mosquito Control District and the Airport Managers depending on suitability of location of operation.

The only functioning airport in Norfolk County is the *Norwood Municipal Airport* and if needed, the SRMCB would contact the Director of the Norfolk County Mosquito Control Project and Airport Manager.

The SRMCB has identified through Norfolk County Mosquito Control Project several sites that can be used for landing zones for helicopters that are town owned, mostly old dumps, which can be utilized if necessary (See Appendix 4).

If aerial adulticiding operations are necessary in Bristol and Plymouth Counties, the SRMCB through its regional mosquito control district (Plymouth County Mosquito Control Project) and contractor has pre-designated the *Plymouth Airport* as a base of operation. The Plymouth County Mosquito Control Project Headquarters could be used (if necessary) for equipment and insecticide delivery. During 2010, the *Westfield-Barnes Airport*, Westfield, Ma was utilized for characterization of spray equipment due to unfavorable conditions at the Plymouth Airport.

Appendix 14: 2012 Mosquito Advisory Group (MAG) Members

The five-member Mosquito and Mosquito-Borne Disease Advisory Group are comprised of the following independent experts: **Note:** *Any correspondence to these individuals should be sent in care of the State Reclamation and Mosquito Control Board, Department of Agricultural Resources, Suite 500, 251 Causeway Street, Boston, MA 02114 or contact directly by e-mail which is listed below.*

1. Dr. Richard Pollack, **MAG Chairman**, Public Health Entomologist, Visiting Researcher, Boston University, Instructor, Harvard School of Public Health Adjunct Assistant Professor, Cummings School of Veterinary Medicine, Tufts University Commissioner, President & Chief Scientific Officer, IdentifyUS LLC

   E-Mail: cimex57@gmail.com

2. Dr. Asim Ahmed specializing in Pediatric Infectious Disease at Children's Hospital-Boston.

   Division of Infectious Diseases
   Children's Hospital Boston
   Harvard Medical School
   300 Longwood Avenue
   Boston, MA 02115-5724

   E-Mail: Asim.Ahmed@childrens.harvard.edu

3. Mr. Jere Downing, Entomologist, Executive Director of the Cranberry Institute (retired) and former University of Massachusetts Biting Fly Specialist

   E-Mail: jeredowning@gmail.com

4. Dr. Anthony (Tony) Kiszewski, Epidemiologist at Bentley College.

   Department of Natural and Applied Sciences
   Bentley College
   175 Forest Street
   Waltham, MA 02452-4713
   E-Mail: akiszewski@Bentley.edu

5. Mr. James Leach, Chief
   Prevention and Sustainability Section
   New York St ate Health Department
   Bureau of Toxic Substance Assessment
   Flanigan Square, Room 330, 547 River Street
   Troy, NY 12180-2216
   E-Mail: jfl03@health.state.ny.us

Appendix 15: Massachusetts Department of Public Health (MDPH)
Massachusetts 2012 Arbovirus Surveillance and Response Plan

Massachusetts Department of Public Health

2012
Massachusetts Arbovirus Surveillance and Response Plan

Linda Han, M.D
Director, Hinton State Laboratory Institute
Massachusetts Department of Public Health

Alfred DeMaria, M.D, Jr.
State Epidemiologist
Massachusetts Department of Public Health

TABLE OF CONTENTS

Executive Summary

The 2012 Massachusetts Department of Public Health's (MDPH) Arbovirus Surveillance and Response plan provides surveillance and phased response guidance for both West Nile virus (WNV) and eastern equine encephalitis virus (EEE). In the past ten years, there have been 68 cases of WNV infection reported in Massachusetts residents and sixteen human cases of EEE resulting in at least nine deaths. This plan reflects a comprehensive review of surveillance activities, mosquito control efforts, public information and risk communication related to arbovirus control in Massachusetts.

The purpose of the plan is to provide guidance on operational aspects of surveillance and response by state and local agencies responsible for the prevention of mosquito-borne disease in the 2012 season. MDPH will continue to seek advice from its partners and collaborators and modify the plan, as appropriate. This document is open to continual review and evaluation. Information is provided to guide planning and actions to reduce the risk of human disease from EEE and WNV.

Key components of the plan include:

- monitoring trends in EEE and WNV activity in Massachusetts;
- timely collection and dissemination of information on the distribution and intensity of WNV and EEE in the environment;
- laboratory diagnosis of WNV and EEE cases in humans, horses and other animals;
- effective communication, advice and support of activities that may reduce risk of infection;
- phased response to provide measures to suppress the risk of infection.

This document provides information about EEE and WNV disease and program goals, and specific guidelines for mosquito, equine and human surveillance. Additionally, this document provides guidance for the dissemination of information, including routine information; media advisories of positive EEE and WNV findings in mosquitoes, as well as public health alerts related to positive EEE and WNV human cases.

This plan describes MDPH's public outreach efforts to provide helpful and accurate communication with Massachusetts' residents about their risk from arboviral diseases and specific actions that individuals and communities can take to reduce this risk.

I. INTRODUCTION

The Massachusetts Department of Public Health, in collaboration with the State Reclamation and Mosquito Control Board (SRMCB) and regional mosquito control projects (MCP), conducts surveillance for mosquito-borne viruses that pose a risk to human health. Surveillance currently focuses on West Nile and eastern equine encephalitis viruses, which are found in the local environment and are capable of causing serious illness and death in humans, horses and other mammals.

The 2012 Massachusetts Surveillance and Response Plan for mosquito-borne diseases is based on a comprehensive plan initially developed for WNV in 2001 in collaboration with local health agencies, other state agencies, academic institutions, the Centers for Disease Control and Prevention (CDC), and interested groups and individuals. It incorporates components of the state's EEE surveillance activities, which began in the 1950's and have continued since that time. Monitoring for WNV began following a 1999 outbreak of human WNV disease in the New York City area, the first known occurrence of this disease in North America. WNV was identified in birds and mosquitoes in Massachusetts during the summer of 2000 and has been found during each consecutive season.

The updated 2012 plan is the result of analyses of surveillance data collected in Massachusetts and the United States. In order to address the complexity and seriousness of the human disease risk posed by EEE, MDPH convened a panel of experts in the fields of ecology, biology, public health, infectious disease and toxicology to review MDPH's surveillance and response program and make recommendations for enhancing the program. In addition, MDPH continues to promote collaborative

efforts with multiple agencies and interest groups by seeking and accepting comment from stakeholders. The purpose of the plan is to provide guidance on operational aspects of surveillance and response by the state and local agencies with responsibilities for the prevention of mosquito-borne disease. MDPH will continue to seek advice from its partners and collaborators, and modify the plan, as appropriate. This document is open to continual review and evaluation, with changes made when there is opportunity for improvement.

II. DISEASE HISTORY AND BACKGROUND

The two principal mosquito-borne viruses (also known as arboviruses, for **ar**thropod-**bo**rne viruses) recognized in Massachusetts, and known to cause human and animal disease are eastern equine encephalitis virus with the first human cases to have been identified in Massachusetts in 1938, and West Nile virus, with the first human case identified in the United States in 1999, and in Massachusetts in 2001.

A. Eastern Equine Encephalitis Virus

1. Background

Eastern equine encephalitis is a serious disease which occurs sporadically in Massachusetts, with 30-50% mortality and lifelong neurological disability among many survivors. The first symptoms of EEE are fever (often 103º to106ºF), stiff neck, headache, and lack of energy. These symptoms show up three to ten days after a bite from an infected mosquito. Inflammation and swelling of the brain, called encephalitis, is the most dangerous and frequent serious complication. The disease gets worse quickly and some patients may go into a coma within a week. There is no treatment for EEE. In Massachusetts, approximately half of the people identified with EEE have died from the infection. People who survive this disease will often be permanently disabled. Few people recover completely.

Historically, clusters of human cases have occurred over a period of 2-3 years, with a variable number of years between clusters. In the years between these case clusters or outbreaks, isolated cases can and do occur. Outbreaks of human EEE disease in Massachusetts occurred in 1938-39, 1955-56, 1972-74, 1982-84, 1990-92, and, 2004-06. Two cases of EEE occurred in both 2010 and 2011; one case each year occurred in visitors to Massachusetts.

Massachusetts Eastern Equine Encephalitis Experience		
Year(s)	Human EEE Cases	Human EEE Deaths
1938-39	35	25
1955-56	16	9
1973-74	6	4
1982-84	10	3
1990-92	4	1
2004-06	13	6
2010	1 (plus 1 non-resident)	0
2011	1 (plus 1 non-resident)	1

The Public Health Service, in collaboration with MDPH, initiated a field surveillance program in 1957; following a 1955-56 outbreak of EEE. The purpose of the program was to gather data to guide prevention and risk reduction of this disease. This program formed the basis for the Commonwealth's current arbovirus program.

2. Risk Factors for Disease Transmission

Eastern equine encephalitis virus is an enzootic alphavirus found in some passerine (perching) bird species living in and around fresh-water swamp habitats. These habitats also support populations of the primary enzootic mosquito vector, *Culiseta melanura*, which feeds predominantly on birds. Although portions of the ecology of EEE virus have yet to be elucidated, the virus has a cycle of natural infection among bird populations with occasional ‘‘incidental” symptomatic infections in susceptible species including humans. The appearance of EEE in late June or early July coincides with the hatching of highly susceptible bird populations. The virus is circulated among the bird population by *Cs. melanura* and under

some circumstances *Cs. morsitans*, another bird-biting mosquito. Depending on when virus circulation begins, the size of the *Culiseta* populations, weather conditions, and probably additional, currently unidentified factors, this virus amplification cycle may eventually spill over and involve secondary, or "bridge", mosquito vectors that feed on both birds and mammals. In the Northeast these bridge vectors are mosquito species such as *Coquillettidia perturbans, Ochlerotatus* (formerly *Aedes*) *canadensis,* and *Aedes vexans*. These bridge vectors are presumed to be responsible for the transfer of EEE to incidental hosts, including humans, horses' llamas, alpacas, emus and ostriches. The swamp habitats, which support large populations of *Cs. melanura* and are the initial source of EEE, are known as endemic foci.

In the Northeast, these endemic foci are large hardwood swamps of mature white cedars and red maples. To grow in the permanently wet swamps, tree roots spread out across the peat soils characteristic of these habitats. These root systems create dark holes, or crypts, that are generally filled with water... These crypts are the preferred ovipositing (egg-laying) sites for *Cs. melanura* and are where the larvae develop. *Culiseta melanura* survives the winter in these crypts. The amount of rainfall during the summer and fall affects the survival of the larvae during the winter and, in part, determines the population of adult mosquitoes the following year.

The risk of EEE infection in humans varies by geographical area in Massachusetts, as well as in the United States, and is correlated with the location of the necessary swamp habitats. In Massachusetts, these areas are most common in southeastern Massachusetts. The majority of EEE cases have occurred in Norfolk, Bristol, and Plymouth counties with some cases also occurring in Middlesex County. A very few cases have also occurred in Essex County and even more rarely in Worcester County or further west. Historically, Barnstable and the Islands of Martha's Vineyard and Nantucket have not had human cases of EEE.

Currently, it is impossible to predict, with complete accuracy, the appearance of EEE and the probability of human EEE infection in any given year. However, over 50 years of surveillance for EEE in Massachusetts has enabled the development of a mosquito-based, EEE surveillance system and the identification of several factors that help provide an estimate of human risk. These estimates are used to alert the residents of the state and guide mosquito control activities. Risk estimates are based on the current level of EEE activity in both enzootic (bird-biting) and epizootic (mammal-biting) vectors, population levels of these mosquito species, recent and historic levels of EEE activity, timing of virus identification in bird-biting and mammal-biting mosquitoes, and prevailing weather conditions.

Temporally and spatially associated human cases are more likely when multiple factors indicate that risk is increasing. Identification of EEE in the enzootic mosquito vector, *Cs melanura*, is useful for determining areas of virus amplification and as a proxy measure of the amount of EEE virus in the environment. Theoretically, the more virus that is circulating between mosquitoes and birds, the more likely it will be to be picked up by a bridge vector mosquito and transmitted to humans. The intensity of enzootic EEE transmission correlates with the abundance of the enzootic vector, *Cs melanura*. Abundant populations of this species provide greater opportunity for the virus to perpetuate or amplify within the bird population. Identification of EEE in bridge vector mosquito species confirms the presence of infected mosquitoes of a species known to feed on humans. The more virus that has spilled over into bridge vector species, the greater the chance that a person will be exposed to the virus. Warm temperatures increase the rate of both mosquito development and virus replication within mosquitoes. Consistently elevated temperatures increase mosquito populations of all species, speed up virus multiplication within mosquitoes, and therefore act to increase the amount of virus in the environment overall.

Other factors that affect the risk of EEE infection for humans are the abundance of specific kinds of mosquitoes at critical periods of the transmission season, groundwater levels, and the timing of rainfall and flooding during the mosquito season. Long-term weather patterns during the fall and winter that produce high ground water levels and snow cover may enhance survival of *Cs. melanura* larval populations. The abundance of these larval populations may serve as an early indicator of the potential for human disease later in the year.

Multiple factors affect the development, survival, and abundance of mosquitoes. It is not currently possible to predict either the abundance of mosquitoes or the risks for encountering an infected vector later in the season.

B. West Nile Virus

1. Background

West Nile virus (WNV) first appeared in the United States in 1999. Since the initial outbreak in New York City, the virus has spread across the US from east to west. WNV infection may be asymptomatic in some people, but it leads to morbidity and mortality in others. WNV causes sporadic disease of humans, and occasionally significant outbreaks. Nationally, 667 human cases of WNV neuroinvasive disease (meningitis and encephalitis) and WNV fever were reported to the CDC in 2011.

The majority of people who are infected with WNV (approximately 80%) will have no symptoms. A smaller proportion of people who become infected (~ 20%) will have symptoms such as fever, headache, body aches, nausea, vomiting, and sometimes swollen lymph glands. They may also develop a skin rash on the chest, stomach and back. Less than 1% of people infected with WNV will develop severe illness, including encephalitis or meningitis. The symptoms of severe illness can include high fever, headache, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness and paralysis. Persons older than 50 years of age have a higher risk of developing severe illness. In Massachusetts, there were at least five fatal WNV human cases identified between 2002-2011, All fatalities were in individuals eighty years of age or older.

Following the identification of WNV in birds and mosquitoes in Massachusetts during the summer of 2000, MDPH arranged meetings between local, state and federal officials, academicians and the public to develop recommendations to adapt the arbovirus surveillance and response plan to include activities appropriate for WNV. Four workgroups addressed the issues of surveillance, risk reduction interventions, pesticide toxicity and communication.

2. Risk Factors for Disease Transmission

West Nile virus is amplified by a cycle of continuous transmission between mosquito vectors and bird reservoir hosts. Infected mosquitoes carry virus and transmit it to susceptible bird species. WNV infection can be fatal in some species of birds, particularly American crows and blue jays (corvids). Confirmation of WNV in dead birds historically provided sentinel information used for assessing the risk of human WNV infections. However, the proportion of susceptible birds has decreased over time so that testing dead birds for the presence of virus is no longer an efficient surveillance tool.

The principal mosquito vectors for West Nile virus on the East Coast are members of the genus *Culex*, primarily *C. pipiens* and *C restuans*. These species may be abundant in urban areas, breeding easily in artificial containers such as birdbaths, discarded tires, buckets, clogged gutters, catch basins and other standing water sources. Both species feed mainly on birds and occasionally on mammals, including humans. Peak feeding activity for these species occurs from dusk into the late evening. Consistently high temperatures and lower precipitation rates are factors that have been associated with higher mosquito infection and human illness rates. Additionally, warmer winter temperature conditions may result in larger numbers of *Culex* species overwintering as adult, with resulting increases in early season *Culex* abundance.

There are additional mosquito species in Massachusetts that can be involved in the transmission of WNV to humans. *Culex salinarius* lives in brackish and freshwater wetlands and feeds on amphibians, birds, and mammals; it is well known for biting humans. *Ochlerotatus japonicus* may be involved in the transmission of both WNV and EEE. This species utilizes natural and artificial containers such as tires and rock pools as larval habitat. It feeds mainly on mammals and is a fierce human biter.

West Nile virus activity varies from year to year. When a large number of infected birds and a high rate of infected mosquitoes occur in a relatively small geographic area, the risk of transmission of virus to

humans is increased. In addition, there is evidence that when meteorological conditions are such that *Cx. restuans* populations are increased relative to *Cx. pipiens*, the risk of transmission to humans may be increased. Surveillance evidence indicates that WNV is established in the United States and that virus activity is likely to occur annually.

A summary of current and historical surveillance information for EEE and WNV in Massachusetts is available online at www.mass.gov/dph/wnv.

C. Other viruses

Although testing for other arboviruses is not routine, MDPH is prepared to rapidly implement screening for other relevant viruses carried by mosquitoes that may impact human health. These agents include dengue and chikungunya viruses, for example. Decisions to implement surveillance for new viruses will be based on information pertaining to new or unusual activity and/or local environmental detection of mosquito vectors that support new viral agents. This is part of an ongoing risk assessment performed by MDPH and CDC's Arbovirus Surveillance Network.

III. PROGRAM GOALS

Timely and accurate information based on surveillance information is used to provide an estimate of the level of risk for human disease from WNV and EEE. Based on this surveillance information, plans and actions to reduce risk can be developed and implemented when needed. Program activities include:

- Testing mosquitoes, horses, humans and other appropriate animals to identify EEE and WNV infections;
- Tracking trends in incidence and prevalence of EEE and WNV infections by geographic area;
- Estimating viral infection rates in mosquitoes;
- Stratification of risk by geographic areas as a function of relative risk of human disease;
- Conducting surveillance for human and animal disease;
- Educating human and animal medical practitioners on the appropriate procedures for detecting infections and disease caused by mosquito-borne viruses;
- Recommending measures to reduce virus transmission and disease risk;
- Educating the public on mosquito-borne diseases and disease risk, and common-sense precautions to reduce the risk of infection; and
- Participating in the national Arbovirus Surveillance Network.

IV. AGENCY ROLES

A. Massachusetts Department of Public Health (MDPH)

The central purpose of arbovirus surveillance is to provide information that will guide planning and activities to reduce the risk of human disease from EEE and WNV infection. To achieve this, the main objectives are to monitor trends in EEE and WNV in Massachusetts; provide timely information on the distribution and intensity of WNV and EEE activity in the environment; perform laboratory diagnosis of WNV and EEE cases in humans, horses and other animals; communicate effectively with officials and the public; provide guidelines, advice and support on activities that effectively reduce risk for disease; and provide information on the safety, anticipated benefits and potential adverse effects of proposed prevention interventions.

MDPH works cooperatively with the SRMCB, regional mosquito control projects and other agencies to collectively identify and support the use of safe and effective mosquito control measures based on integrated pest management (IPM) principles. The use of pesticides as a means to reduce human risk is one of several methods/strategies.

B. State Reclamation and Mosquito Control Board (SRMCB)

The SRMCB oversees mosquito control programs and activities in the Commonwealth of Massachusetts. The SRMCB consists of three (3) members representing the Department of Agricultural Resources (DAR), Department of Conservation and Recreation (DCR), and Department of Environmental Protection (DEP). Additionally, the SRMCB advises its respective state agency Commissioners on actions to reduce mosquito populations based on MDPH findings and characterization of risk.

The SRMCB's 'Operational Response Plan to Reduce the Risk of Mosquito-Borne Disease in Massachusetts' addresses the issues related to the operational aspects of adult mosquito surveillance and control to prevent and/or reduce the risk of mosquito-borne diseases. The plan may be viewed online at www.mass.gov/agr/mosquito/arbovirus.htm.

In 2006, the SRMCB created a SRMCB Mosquito Advisory Group (MAG). The MAG is composed of scientific experts from the fields of medical entomology, infectious disease, and mosquito control, and provides independent scientific advice to the SRMCB to assist them in evaluating and assessing data from both MDPH and mosquito control projects.

C. Mosquito Control Projects (MCPs)

There are nine (9) organized Mosquito Control Projects or Districts located throughout Massachusetts. All of the mosquito control activities of these organized agencies are performed under the aegis of the SRMCB. MCPs collaborate with local boards of health in their jurisdictions to control mosquitoes. These locally authorized efforts employ a variety of targeted activities for source reduction, larviciding and adulticiding that are in compliance with the SRMCB Operational Response plan. Additional details relating to control strategies may be found within the SRMCB Operational Plan.

V. SURVEILLANCE

A. Massachusetts Department of Public Health

Surveillance of mosquitoes for arboviruses is a core function of MDPH. Monitoring mosquitoes for the presence of virus provides an estimate of risk to humans. Massachusetts has a long-term field surveillance program that was initiated in 1957 for EEE and was enhanced in 2000 to include WNV surveillance. The extensive experience in Massachusetts with surveillance for mosquito-borne disease provides expertise and capacity to guide risk reduction efforts. MDPH uses a comprehensive and flexible strategy that modifies certain surveillance activities in response to trends in disease risk.

On an ongoing basis, MDPH monitors national and regional surveillance data and current scientific literature to assess risk of newly emerging arboviruses in Massachusetts. In addition, defined subsets of mosquito pools will be tested for the presence of new or emerging viruses

1. Fixed and Long-Term Trap Sites

MDPH field staff collects mosquitoes from areas with activity during the previous year, and from long-term trap sites maintained in the EEE high-risk areas of southeastern and eastern Massachusetts (Figure 1). Trapping of gravid mosquitoes for WNV testing is conducted both by MCPs and MDPH field staff at various locations throughout the state during the arbovirus season. At the William A. Hinton State Laboratory Institute (HSLI), MDPH tests samples (pooled sets of 10- 50 mosquitoes) for WNV and EEE. Test results from routine mosquito collections are available within 24 hours after delivery of mosquitoes to HSLI. Fixed and long-term trap sites provide the best available baseline information for detecting trends in mosquito abundance and virus prevalence, and for estimating the relative risk of human infection from EEE virus and WNV. MDPH field staff monitor larvae from select sites in late fall and early spring to

determine end-season and pre-season larval abundance. Informal monitoring of larval abundance from these sites continues on a weekly basis during the arbovirus season.

2. Supplemental Trap Sites

When EEE or WNV activity is detected in an area, additional trap sites and/or trap types are used to obtain more information regarding the intensity of virus activity in mosquitoes. The following risk indicators may result in the implementation of more intensive mosquito trapping: 1) virus isolations in mosquitoes; 2) emergence of large numbers of human-biting mosquitoes in an area with a high rate of virus activity and 3) identification of human or animal cases.

3. Mosquito Control Project Trap Sites

Massachusetts Mosquito Control Projects (MCPs), use a variety of available control strategies to impact mosquito abundance. Monitoring mosquito abundance is accomplished through various surveillance methods including but not limited to larval dip counts and the use of light/ CO_2 baited traps and gravid traps.

B. Avian Surveillance

MDPH discontinued avian surveillance for WNV as of April, 2009. When the virus was first introduced into the United States, WNV caused high mortality rates in certain species of birds, particularly corvids, thus reporting and testing of dead birds was a productive way to detect and monitor WNV activity in an area. However, in recent years, the tracking and testing of dead birds has become significantly less useful as a surveillance tool. Monitoring mosquitoes for presence of virus is the primary predictive indicator of human arbovirus disease risk. Therefore, the routine laboratory testing of dead wild birds for West Nile virus (WNV) has been eliminated. This is consistent with recent policy changes in multiple states.

Most birds that are infected with EEE virus survive the viremia, making individual dead bird EEE monitoring impractical. Non-native bird species such as emus, ostriches and exotic game birds are highly susceptible to EEE and infections within farmed flocks have occurred in Massachusetts. Testing of highly suspect bird specimens for EEE and/or WNV infection is done on an as-needed basis as determined by MDPH.

A 24/7 information line (1-866-MassWNV) is maintained during the arbovirus season. Callers receive recorded messages that provide information on why birds are no longer tested, information on WNV/EEE disease and instructions for proper disposal of dead birds. More detailed information on this topic is available on the MDPH website.

C. Animal Surveillance

Specimens from horses and other domestic animals that have severe neurological disease suspected of being caused by EEE or WNV infection are tested at SLI. Testing may take up to nine working days to complete. Veterinarians, DAR, the United States Department of Agriculture (USDA) and Tufts University Cummings School of Veterinary Medicine collaborate with MDPH to identify and report suspect animal cases. In addition, blood and/or tissue samples from animals from other sources, such as zoos, horse stables or the wild are tested, as appropriate. Current information on WNV and EEE infections in horses, along with clinical specimen submission procedures, are disseminated to large animal veterinarians, stable owners and others through various distribution methods and are posted on the MDPH arbovirus website at www.mass.gov/dph/wnv. Horses and other animals can be immunized against infection with WNV and EEE with available veterinary vaccines. Vaccination is the primary means of preventing infection in animals.

D. Human Surveillance

1. Routine surveillance

Specimens from human cases of encephalitis and meningoencephalitis are submitted to MDPH and screened for WNV and EEE. Testing may take up three to seven days to complete. Occasionally, testing cannot be completed at HSLI and samples are forwarded to the Centers for Disease Control and Prevention (CDC) for additional testing. Time to receipt of final results from CDC is variable. Current information on WNV and EEE infections in humans, along with clinical specimen submission procedures, are disseminated to physicians (infectious disease, emergency medicine and primary care), emergency department directors and hospital infection control practitioners through various distribution methods and are posted on the MDPH arbovirus website at www.mass.gov/dph/wnv.

2. Active surveillance

If surveillance data estimate a high risk of human disease, active surveillance may be instituted in targeted areas. Active surveillance involves regularly contacting local health care facilities to communicate current surveillance information, promoting disease prevention strategies, reviewing specimen submission procedures and highlight the need for testing patients presenting with signs and symptoms possibly representing infection with EEE virus or WNV. The Health and Homeland Alert Network (HHAN), a secure electronic alerting system, is used to send information to local boards of health upon confirmation of EEE or WNV in any specimen.

3. Pesticide related surveillance

Outreach on pesticide illness reporting is coordinated by the MDPH's Bureau of Environmental Health. In the event of an aerial pesticide application, active surveillance efforts will be implemented with emergency departments and intensified outreach efforts will be made to health care providers.

VI. Communication of Surveillance Information

MDPH works with the SRMCB and MCPs to identify and support the use of risk reduction and disease prevention methods that are specific to the causes of disease, and supports planning and practices which incorporate the most appropriate prevention methods. Additionally, MDPH routinely communicates with health agencies in neighboring states to share relevant arbovirus findings.

Prior to the beginning of the arbovirus season, general disease information and specimen submission procedures are provided to local boards of health via the HHAN. The local boards of health (LBOH) are asked to provide routine and emergency contact information for a primary and secondary arbovirus contact during the season. Although routine surveillance specimen notifications are scheduled during normal business hours, test results sometimes become available after hours. General information and fact sheets are posted on the MDPH arbovirus website and are available publicly.

Laboratory confirmation of a human WNV or EEE case is immediately reported by telephone to the submitting physician, and LBOH in the town where the case resides. If the LBOH cannot be reached via telephone in a timely manner, a severe level HHAN alert is sent.

Laboratory confirmation of WNV or EEE in a veterinary specimen is immediately reported by telephone to the submitting veterinarian, the DAR Division of Animal Health, and the LBOH. If the LBOH cannot be reached via telephone in a timely manner, a severe level HHAN alert is sent.

Initial identification of virus in mosquitoes from a given town is reported to the LBOH and MCP by telephone. Adjacent towns are notified via a moderate level HHAN alert. In order to encourage risk communication on a larger focal area level rather than a city/town level, all subsequent positive findings in mosquitoes are reported once daily to all affected towns and adjacent towns, via a moderate level HHAN alert. All subsequent positive mosquito findings will be reported once daily to all MCPs and the SRMCB.

The MDPH Regional Health Office (RHO) in the area will offer assistance with local response. All laboratory confirmed results for WNV and EEE in humans, veterinary specimens, and mosquitoes are provided to the RHO, MCPs and members of the SRMCB once the LBOH has been notified.

At the time of notification, MDPH encourages LBOH to share the information with other local agencies and high-risk populations in their community, as appropriate. MDPH provides LBOH with sample press releases for their use. Depending on the circumstances, MDPH may also issue a public health alert. In addition, weekly summaries of results from mosquito samples submitted and tested will be posted by town as News Items on the HHAN.

After all appropriate individuals and agencies have been notified, positive surveillance findings are made available to the media and general public on the MDPH Arbovirus website at **www.mass.gov/dph/wnv**. This website, which also includes links to a variety of educational materials related to mosquito-borne diseases, is updated on a daily basis throughout the arbovirus season. Results are also reported to the CDC's ArboNET reporting system.

MDPH issues public health alerts through the media when surveillance information indicates an increased risk of human disease or if a significant surveillance event occurs (for example, the first arbovirus activity of the season). In general, alerts include current surveillance information and emphasize prevention strategies.

VII. Prevention and Response: Recommendations for Phased Response to Surveillance Data

The guidance provided here is based on current knowledge of risk for human disease, and appropriateness and efficacy of interventions available to reduce that risk. Multiple factors contribute to the risk for mosquito-transmitted human disease. Decisions about risk reduction measures should be made after consideration of surveillance information.

Public awareness of what can be done to reduce risk of infection is of utmost importance. Typically, risk for any individual is expected to be relatively low, and the routine precautions taken by individuals may be sufficient to reduce opportunities for infection. Routine precautions should include:

- avoiding outdoor activity in areas and during times of day with increased mosquito activity;
- use of mosquito repellents containing and FDA-approved active ingredient; and
- use of clothing to reduce mosquito access to skin and
- avoiding outdoor activity in areas and during times of day with increased mosquito activity.

These personal protective measures must form the basis of all risk reduction and the need to utilize them is not alleviated by any mosquito control activities. Risk for mosquito-borne disease persists until the first local hard frost kills all remaining adult mosquitoes.

When multiple factors that indicate an increased risk for transmission to humans are present, additional risk reduction measures may be necessary. These guidelines take into consideration the complexity of reducing risk of human disease from EEE and WNV infection, and form a framework for decision-making by both individuals and agencies.

General guidelines are provided for an array of situations as noted in the Surveillance and Response Plan tables that follow. Specific situations must be evaluated individually and options discussed before actions are taking. Estimating risk from mosquito-borne disease(s) is complex and many factors modify specific risk factors. MDPH assesses risk and works with LBOH, MCPs, and the SRMCB to develop the most appropriate response activities to reduce the risk of human disease. There is no single indicator that can provide a precise measure of risk, and no single action that can completely assure prevention of infection.

MDPH works collaboratively with other state agencies, the SRMCB and MCPs to collectively identify and support the use of safe and effective mosquito control measures based on integrated pest management (IPM) principles.

A. MDPH Guidance

MDPH uses data from arbovirus surveillance to assess human risk levels as outlined in the phased response tables of this plan. Risk levels are defined for "focal areas". Focal areas may incorporate multiple communities, towns or cities, and parts thereof. Factors considered in the estimation of human risk in a focal area include: mosquito habitat, prior virus isolations, human population densities, timing of recent isolations of virus in mosquitoes, current and predicted weather patterns and seasonal conditions needed to present risk of human disease.

If the risk for multiple human infections becomes widespread and involves multiple jurisdictions, MDPH will convene the SRMCB, MCPs, and MAG to get their recommendation for appropriate mosquito control interventions to reduce public health risk. The SRMCB will provide recommendations on appropriate pesticide(s), route and means of treatment for the specific treatment areas. Interventions may include state-funded aerial application of mosquito adulticide. Assessment of the need for and utility of, a focal or large-scale aerial application of mosquito adulticide includes evaluating evidence that the seasonal and biological conditions present a persistent risk of human disease, and that those same conditions permit the effective use of an aerially applied pesticide.

B. Risk Reduction and Prevention Guidance for Seasons with Indicators of Increased EEE Risk

Based on historical experience with EEE, MDPH has identified specific critical indicators for overall EEE, risk, and provides specific risk reduction and prevention guidance for seasons with an anticipated increased EEE risk. Activities that may be undertaken in response to indicators of increased risk include:

- MDPH may release public health alerts throughout the season to remind the public of the steps to take to reduce their risk of exposure to mosquitoes.
- Local municipalities may be encouraged to reschedule outdoor evening events to avoid the period between dusk and dawn which correspond to peak mosquito activity.
- MCPs may increase their source reduction activities to reduce mosquito-breeding habitats and to reduce adult mosquito abundance. This may include ground and aerial larviciding.
- After sustained findings of positive mosquito isolates, if not already in progress, adult mosquito control efforts including targeted ground adulticiding operations should be considered. The decision to use ground-based adult mosquito control will depend on critical modifying variables including the time of year, mosquito population abundance and proximity of virus activity to at-risk populations.
- Other intensified efforts may be implemented following coordination between MDPH and other agencies including DEP, DAR, and DCR.

Aerial Adulticide Application in Response to Mosquito-Borne Disease Threat
2012 Multi-Agency Response Flowchart

1. Determination of Response

- When human risk is elevated to a high level of concern as indicated by the MDPH Surveillance and Response Plan; DPH will determine, in consultation with Mosquito Control Projects, SRMCB and the Mosquito Advisory Group whether aerial application is warranted.

2. Characterization of Area of Risk

- Once consensus is obtained, DPH characterizes the area of risk and delineates the perimeter of the spray area based on mosquito and virus surveillance.
- DPH/BID provides the GIS perimeter map to inter-agency collaborators as soon as possible.

3. Commissioner Certification

- DPH/BID requests that the Commissioner of Public Health issue a "Certification that Pesticide Application is Necessary to Protect Public Health"

Action Items 4a-4c Occur Simultaneously:

4a. Determination of Appropriate Pesticide

- Prior to July 1 of each season, DPH/BEH and DAR will determine the type of pesticide to be used in the event that an aerial application will be warranted and obtain any EPA pesticide waivers, if necessary, for use in aerial application.
- In the event that aerial application is warranted, DPH/BEH and DAR will confirm this selected pesticide for use.

4b.Determination of No-Spray Zones

- Aerial no-spray zones (mosquito treatment sensitive areas data layers) defined:
  1)Certified organic farms
  2)Priority habitats for federally listed endangered and threatened species
  3)Surface water supply resource areas
  4)Commercial fish hatcheries/aquaculture
- DAR reviews any emergency waivers needed to use pesticides on school property and ensure compliance with pesticide laws.
- DAR/SRMCB will submit a 'Notice of Intent' to EPA to obtain an NPDES permit within 30 days of the aerial adulticide event.

4c.Exclusion/Inclusion of Priority Habitats:

- DPH will determine, in consultation with SRMCB, DAR, DEP, and DFW if spraying in mosquito treatment sensitive areas is necessary to protect the public health.
- If spraying in these areas is necessary to reduce the risk to public health then:
  - DPH requests a permit from DFW be issued to DAR for taking endangered, threatened, or special concern species.

5. Preparation of Final GIS Data Map

- DAR coordinates compilation of mosquito treatment sensitive areas data layers (no-spray zones) developed by DAR, DFW, and DEP within designated DPH spray area into a final map.

6. Environmental Monitoring

- DEP, DAR, and DPH/BEH notify partner environmental agency collaborators of planned environmental monitoring to provide opportunity for input/collaboration.

DEP, DAR, and DPH/(BEH/BLS) initiate plans for pre/post-monitoring for public drinking water reservoirs, honey bees, macro-invertebrates, and cranberries in designated spray area.

7. Emergency Room and Poison Control Contacts

- DPH/BEH contacts and provides pesticide illness surveillance protocols to emergency departments, poison control centers, and local health departments.

8. Notification of Date & Time of Application

- DAR and DPH provide public notices regarding the locations, dates, and times of aerial spraying.
- DAR will maintain a website with GIS maps of the aerial spray area and will update this site daily during spray operations.
- DPH will provide recorded hotline information regarding the spray zone, precautionary measures, and telephone numbers to report fish kills or other environmental impacts.

9. Operational Procedures-Aerial Application

- DAR/SRMCB initiates aerial spray operations using collective guidance and consensus developed through multi-agency, cross secretariat process.
- The aerial application operational procedures are followed as described in the SRMCB Operational Response Plan.

DPH- Department of Public Health
BID- Bureau of Infectious Diseases
BEH- Bureau of Environmental Health
BLS- Bureau of Laboratory Sciences

DAR- Department of Agricultural Resources
SRMCB- State Reclamation and Mosquito Control Board
DFG-Department of Fish and Game
DFW- Division of Fisheries and Wildlife

Table 1. Guidelines for Phased Response to WNV Surveillance Data

Risk Category	Probability of locally acquired human disease	Definition of Risk Category for a Focal Area[2]	Recommended Response
1	Remote	All of the following conditions must be met: **Prior Year** No prior year WNV activity detected in the focal area. And **Current Year** No current surveillance findings indicating WNV activity in mosquitoes in the focal area And No animal or human cases.	
2	Low	Prior Year Any WNV activity in mosquitoes in the community or focal area Or Current Year 1. Sporadic WNV activity in mosquitoes in the focal area. And 2. No animal or human cases Definitions: ***Sporadic*** WNV activity- when 1-2 mosquito isolates are detected during non-consecutive weeks within one focal area. ***Sustained*** WNV activity- when mosquito isolates are detected for 2 or more consecutive weeks within one focal area.	Response as in category 1, plus: 1. Expand community outreach and public education programs, particularly among high-risk populations, focused on risk potential and personal protection, emphasizing source reduction. 2. Increase larval control and source reduction measures. 3. Public health alert sent out by MDPH in response to first WNV virus positive mosquito pool detected during the season. The alert will summarize current surveillance information and emphasize personal prevention strategies. 4. Locally determined standard adult mosquito control activities continue.

[2] Focal Area- May incorporate multiple communities, towns or cities, or parts thereof. Factors considered in determination of human risk in a focal area include mosquito habitat, prior isolations, human population densities, timing of current isolations of virus in mosquitoes, weather patterns, time of season conditions needed to present risk of human disease

3	Moderate	**Prior Year** Confirmation of one or more human or animal WNV cases; or sustained WNV activity in mosquitoes for 2 or more weeks. Or Current year 1. Sustained WNV activity or multiple isolations during the same week plus at least one multiple meteorological or ecological conditions (such as above average temperatures, dry conditions, or larval abundance) associated with increased abundance and increased risk of human disease. And 3. No animal or human WNV cases	Response as in category 2, plus: 1. Outreach and public health educational efforts are intensified including media alerts as needed. 2. If not already in progress, standard, locally determined adult mosquito control efforts including targeted ground adulticiding operations should be considered against *Culex* mosquitoes and other potential vectors, as appropriate. The decision to use ground-based adult mosquito control will depend on critical modifying variables including the time of year, mosquito population abundance and proximity of virus activity to at-risk populations. 3. Duly authorized local officials may request that DPH Commissioner issue a certification that pesticide application is necessary to protect public health in order to preempt homeowner private property no-spray requests. 4. Supplemental mosquito trapping and testing may be performed in areas with positive WNV findings. 5. Local boards of health are contacted via phone or HHAN (Health and Homeland Alert Network) upon confirmation of WNV in any specimen. Advise health care facilities of increased risk status and corresponding need to send specimens to SLI for testing.

4	High	**Current Year** 1. Sustained or increasing WNV activity in mosquitoes plus multiple meteorological or ecological conditions (such as above average temperatures, dry conditions, increased larval abundance) associated with elevated mosquito abundance; and increasing minimum infection rates. And/or 2. MDPH confirmation of WNV in an animal at any time And/ or, 3. MDPH confirmation of WNV in a human at any time	Response as in category 3, plus: 1. Intensify public education on personal protection measures including avoiding outdoor activity during peak mosquito hours, wearing appropriate clothing, using repellents and source reduction. a. Utilize multimedia messages including public health alerts from MDPH, press releases from local boards of health, local newspaper articles, cable channel interviews, etc. b. Encourage local boards of health to actively seek out high-risk populations in their communities (nursing homes, schools, etc.) and educate them on personal protection d. Advisory information on pesticides provided by MDPH Bureau of Environmental Health. e. Urge towns and schools to consider rescheduling outdoor events. 2. Intensify and expand active surveillance for human cases. 3. Intensify larviciding and/or adulticiding control measures where surveillance indicates human risk. Local, ground- based ULV applications of adulticide may be repeated as necessary to achieve adequate mosquito control. Town or city may request preemption of homeowner private property no-spray requests. 4. Local officials should evaluate all quantitative indicators including population density and time of year and may proceed with focal area aerial adulticiding. 5. Duly authorized local officials may request that the DPH Commissioner issue a certification that pesticide application is necessary to protect public health in order to preempt homeowner private property no-spray requests. 6. MDPH will confer with local health officials, SRMCB and Mosquito Control Projects to determine if the risk of disease transmission threatens to cause multiple human cases and warrants classification as level 5.

5	Critical	**Current Year** 1. More than 1 confirmed human or animal case in a community or focal area Or 2. Multiple quantitative measures indicating critical risk of human infection (e.g. early season positive surveillance indicators, and sustained elevated field mosquito infection rates, and horse or mammal cases indicating escalating epizootic activity)	Response as in category 4, plus: 1. Continued highly intensified public outreach messages on personal protective measures. Frequent media updates and intensified community level education an outreach efforts. 2. MDPH will confer with local health agencies, SRMCB and Mosquito Control Projects to discuss the use of intensive mosquito control methods and determine if measures need to be taken by the agencies to allow for and assure that the most appropriate mosquito control interventions are applied to reduce risk of human infection. These interventions may include state-funded aerial application of mosquito adulticide. Factors to be considered in making this decision include the seasonal and biological conditions needed to present a continuing high risk of WNV human disease and that those same conditions permit the effective use of an aerially applied pesticide. Once critical human risk has been identified, the SRMCB will determine the adulticide activities that should be implemented in response to identified risk by making recommendations on: A. Appropriate pesticide B. Extent, route and means of treatment C. Targeted treatment areas 3. MDPH Bureau of Environmental Health will initiate active surveillance via emergency departments and with health care provides only if aerial spraying commences. 4. MDPH will designate high-risk areas where it has issued a certification that pesticide application is necessary to protect public health in order to preempt homeowner private property no-spray requests. If this becomes necessary, notification will be given to the public. 5. MDPH recommends restriction of group outdoor activities, during peak mosquito activity hours, in areas of intensive virus activity. 6. MDPH will communicate with health care providers in the affected area regarding surveillance findings and encourage prompt sample submission from all clinically suspect cases.

Table 2. Guidelines for Phased Response to EEE Surveillance Data

Risk Category	Probability of locally acquired human disease	Definition of Risk Category for a Focal Area[3]	*Recommended Response*
1	Remote	All of the following conditions must be met: Prior Year No EEE activity detected in a community or focal area And Current Year No current surveillance findings indicating EEE activity in mosquitoes in the focal area And No animal or human EEE cases.	1. MDPH staff provides educational materials and clinical specimen submission protocols to targeted groups involved in arbovirus surveillance, including, but not limited to, local boards of health, physicians, veterinarians, animal control officers, and stable owners. 2. Educational efforts directed to the general public on personal prevention steps and source reduction, particularly to those populations at higher risk for severe disease (e.g., the elderly). 3. Routine collection and testing of mosquitoes. 4. Assess mosquito populations, monitor larval and adult mosquito density. 5. Initiate source reduction; use larvicides at specific sites identified by entomologic survey and targeted at the likely amplifying bridge vector species. In making a decision to use larvicide consider the prevalence of Culiseta and bridge vector larvae, intensity of prior virus activity, and weather. 6. Locally established, standard, adult mosquito control activities are implemented. No specific supplemental control efforts are recommended. 7. Passive human and animal surveillance. 8. Emphasize the need for schools to comply with MA requirements for filing outdoor IPM plans.

[3] Focal Area- May incorporate multiple communities, towns or cities, or parts thereof. Factors considered in determination of human risk in a focal area include mosquito habitat, prior isolations, human population densities, timing of current isolations of virus in mosquitoes, weather patterns, time of season conditions needed to present risk of human disease

2	Low	Prior Year EEE activity in bird biting mosquitoes only in the prior year in the focal area Or Current Year 1. Sporadic EEE isolations in *Cs. melanura* mosquito in the community or focal area after July 1 And 2. No animal or human cases. Definitions: ***Sporadic*** EEE activity- when 1-2 mosquito isolates are detected during non-consecutive weeks within one focal area. ***Sustained*** EEE activity- when mosquito isolates are detected for 2 or more consecutive weeks within one focal area.	Response as in category 1, plus: 1. Expand community outreach and public education programs, particularly among high-risk populations, focused on risk potential and personal protection, emphasizing source reduction. 2. Increase larval control and source reduction measures. 3. Locally established standard adult mosquito control activities continue 4. Public health alert sent out by MDPH in response to first EEE mosquito isolate detected during the season. The alert will summarize current surveillance information and emphasize personal prevention strategies.
3	Moderate	**Prior Year** **Confirmation of one human or animal EEE case in the community or focal area; sustained EEE activity in bird-biting mosquitoes; or EEE isolate from mammal-biting mosquitoes.** Or Current year 1. No animal or human EEE cases in current year And 2. A single positive EEE isolate in any mosquito species prior to July 1 Or 3. Sustained EEE activity in *Cs. melanura* after July 1 with minimum infection rates that are at or below mean levels for focal area trap sites Or 3. A single EEE isolate from mammal-biting mosquitoes (bridge vector species) Or 4. Sustained EEE activity plus at least one multiple meteorological or ecological condition (rainfall, temperature, seasonal conditions, or larval abundance) associated with elevated mosquito abundance and thus likely to increase the risk of human disease	

4	High	Current Year 1. Sustained or increasing EEE activity in *Cs. melanura* with weekly mosquito minimum infection rates above the mean. Or 2. 2 or more EEE isolates from mammal-biting mosquitoes And/or 3. Sustained or increasing EEE activity in mosquitoes plus multiple meteorological or ecological conditions (rainfall, temperature, seasonal conditions, or larval abundance) associated with elevated mosquito abundance and thus very likely to increase the risk of human disease.	Response as in category 3, plus: 1. Intensify public education on personal protection measures including avoiding outdoor activity during peak mosquito hours, wearing appropriate clothing, using repellents and source reduction. a. Utilize multimedia messages including public health alerts from MDPH, press releases from local boards of health, local newspaper articles, cable channel interviews, etc. b. Encourage local boards of health to actively seek out high-risk populations in their communities (nursing homes, schools, workers employed in outdoor occupations, etc.) and educate them on personal protection d. Advisory information on pesticides provided by MDPH Bureau of Environmental Health. e. Urge towns and schools to consider rescheduling outdoor, evening events. 2. Intensify larviciding and/or adulticiding control measures where surveillance indicates human risk. Local, ground- based ULV applications of adulticide may be repeated as necessary to achieve adequate mosquito control. Town or city may request preemption of homeowner private property no-spray requests. 3. Active surveillance for human cases is intensified. Health care facilities are advised of increased risk status and corresponding needs to send specimens to HSLI for testing. 4. Local officials should evaluate all quantitative indicators including population density and time of year and may proceed with focal area aerial adulticiding. 5. Duly authorized local officials may request that the DPH Commissioner issue a certification that pesticide application is necessary to protect public health in order to preempt homeowner private property no-spray requests. **6. MDPH will confer with local health officials, SRMCB and MCPs to determine if the risk of disease transmission warrants classification as level 5.** **7. MDPH will confer with local health agencies, SRMCB and Mosquito Control Projects to discuss the use of intensive mosquito control methods. If elevated risk is assessed in multiple jurisdictions and evidence exists that risk is likely to either increase (based on time of season, weather patterns, etc.) or remain persistently elevated, the interventions may include state-funded aerial application of mosquito adulticide.**

† See Appendix 2 for schedule of recommended cancellation time for use

5	Critical	Current Year 1. Multiple quantitative measures indicating critical risk of human infection (e.g. early season positive surveillance indicators, and sustained high mosquito infection rates, and horse or mammal case indicating escalating epizootic activity) Or 2. A single confirmed EEE human or animal case	Response as in category 4, plus: 1. Continued highly intensified public outreach messages on personal protective measures. Frequent media updates and intensified community level education an outreach efforts. Strong recommendation for rescheduling of outdoor, evening events. 2. MDPH will confer with local health agencies, SRMCB and Mosquito Control Projects to discuss the use of intensive mosquito control methods and determine the measures needed to be taken by the agencies to allow for and assure that the most appropriate mosquito control interventions are applied to reduce risk of human infection. These interventions may include state-funded aerial application of mosquito adulticide. Factors to be considered in making this decision include the seasonal and biological conditions needed to present a continuing high risk of EEE human disease and that those same conditions permit the effective use of an aerially applied pesticide. Once critical human risk has been identified, the SRMCB will determine the adulticide activities that should be implemented in response to identified risk by making recommendations on: A. Appropriate pesticide B. Extent, route and means of treatment C. Targeted treatment areas 3. MDPH Bureau of Environmental Health will initiate active surveillance via emergency departments and with health care provides only if aerial spraying commences. 4. MDPH will designate high-risk areas where individual no spray requests may be preempted by local and state officials based on this risk level. If this becomes necessary, notification will be given to the public. 5. MDPH recommends restriction of group outdoor activities, during peak mosquito activity hours, in areas of intensive virus activity. 6. MDPH will communicate with health care providers in the affected area regarding surveillance findings and encourage prompt sample submission from all clinically suspect cases.

† See Appendix 2 for schedule of recommended cancellation time for use

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Appendix 1: Mosquitoes Associated with Arboviral Activity in Massachusetts

Aedes vexans – Is a common nuisance mosquito. Temporary flooded areas such as woodland pools and natural depressions are the preferred larval habitat of this mosquito. It feeds on mammals and is a fierce human biter. This species is typically collected from May to October. *Ae vexans* is an epizootic (bridge) vector of eastern equine encephalitis (EEE) virus.

Coquillettidia perturbans - Cattail marshes are the primary larval habitat of this mosquito. It feeds on both birds and mammals. It is a persistent human biter and one of the most common mosquitoes in Massachusetts. This species is typically collected from June to September. *Cq perturbans* is an epizootic (bridge) vector of EEE virus.

Culex pipiens – Artificial containers are the preferred larval habitat of this mosquito. It feeds mainly on birds and occasionally on mammals. It will bite humans, typically from dusk into the evening. This species is regularly collected from May to October but can be found year round as it readily overwinters in man-made structures. *Cx pipiens* is the primary vector of West Nile Virus (WNV).

Culex restuans – Natural and artificial containers are the preferred larval habitat of this mosquito. It feeds almost primarily on birds but has been known to bite humans on occasion. This species is typically collected from May to October but can be found year round as it readily overwinters in man-made structures. *Cx restuans* has been implicated as a vector of WNV.

Culex salinarius – Brackish and freshwater wetlands are the preferred habitat of this mosquito. It feeds on birds, mammals, and amphibians and is well known for biting humans. This species is typically collected from May to October but can be found year round as it readily overwinters in natural and man-made structures. *Cx salinarius* may be involved in the transmission of both WNV and EEE.

Culiseta melanura –White cedar and red maple swamps are the preferred larval habitat of this mosquito. It feeds almost exclusively on birds. This species is typically collected from May to October. *Cs melanura* is the primary enzootic vector of EEE.

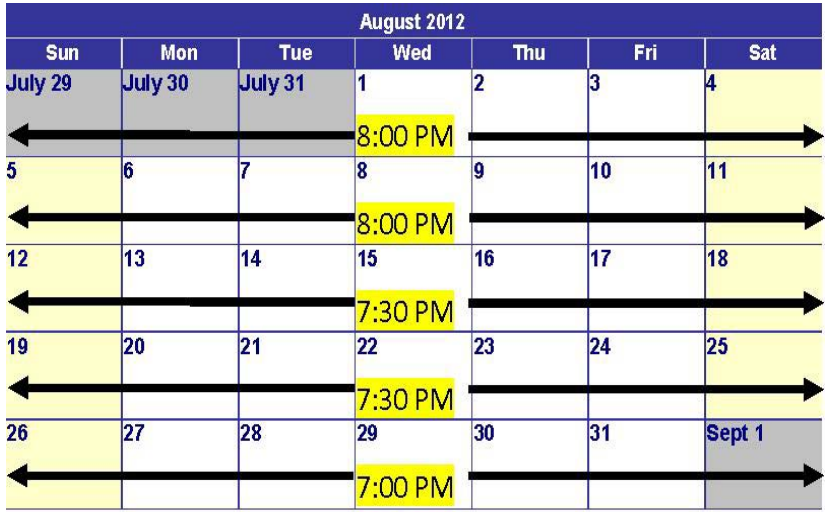
Ochlerotatus canadensis – Shaded woodland pools are the preferred larval habitat of this mosquito. It feeds mainly on birds and mammals but is also known to take blood meals from amphibians and reptiles. This mosquito can be a fierce human biter near its larval habitat. This species is typically collected from May to October. *Oc canadensis* is an epizootic (bridge) vector of eastern equine encephalitis EEE virus.

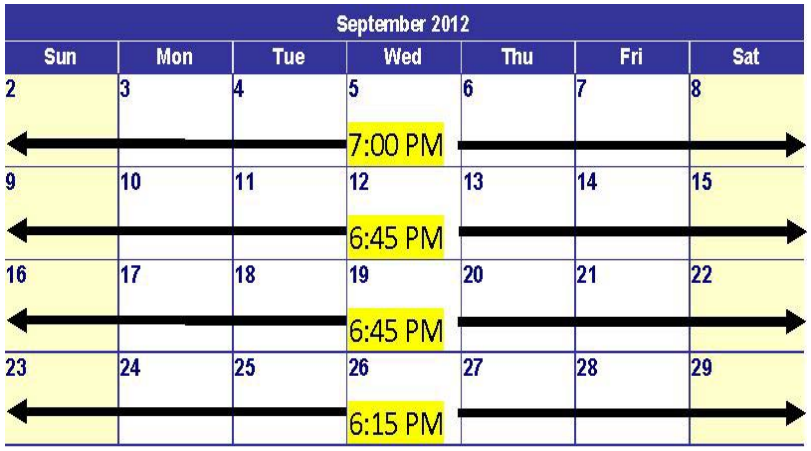
Ochlerotatus japonicus – Natural and artificial containers such as tires, catch basins, and rock pools are the preferred larval habitat of this mosquito. It feeds mainly on mammals and is a fierce human biter. This species is typically collected from May to October. *Oc japonicus* may be involved in the transmission of both WNV and EEE.

APPENDIX 2: RECOMMENDED CANCELLATION TIMES FOR OUTDOOR ACTIVITIES IN AREAS OF HIGH RISK FOR EASTERN EQUINE ENCEPHALITIS (EEE) 2012

The types of mosquitoes most likely to transmit EEE infection are likely to be out searching for food (an animal to bite) at dusk, the time period between when the sun sets and it gets completely dark (and continue to be active thereafter). **The exact timing of this increased activity is influenced by many factors including temperature, cloud cover, wind and precipitation and cannot be predicted precisely for any given day**. Here, the approximate time of sunset was used to establish standardized recommendations for cancellation times of outdoor activities during periods of high EEE risk.

This does not eliminate risk nor does it alleviate the need for the use of repellants or clothing for protection from mosquitoes.





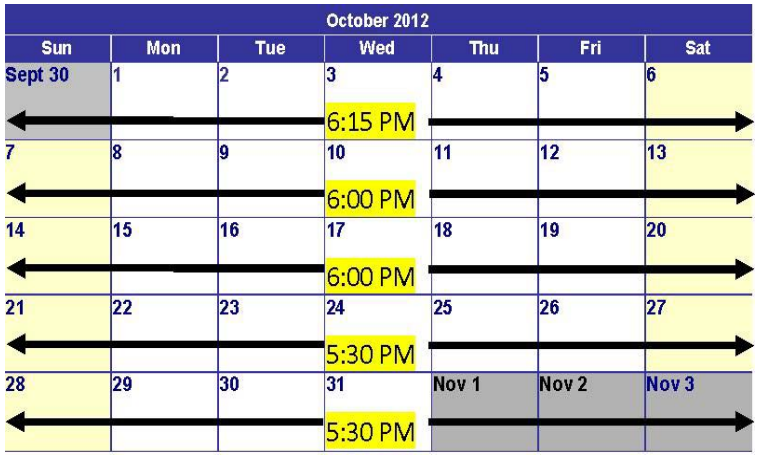


Figure 1: Location of MDPH EEE Long-Term Mosquito Trap Sites